Table of fall, drainage areas, flow, etc., of the Rock river.

Locality.	Distance from source.	Distance from preceding station.	Fall from source.	Fall from preceding station.	Drainage area above station.	Flow per second past station in cubic feet.		Theoretical power under 10 feet head.	
						Ordinary low flow.	Average flow.	Ordinary low flow.	Average flow.
	Miles.	*Miles.*	*Feet.*	*Feet.*	*Sq. miles.*	*Cubic feet.*	*Cubic feet.*	*H. P.*	*H. P.*
Utmost source									
Former outlet of lake Horicon	25	25	20	20	497	179	450	203	511
Above mouth of Crawfish river	80	55	93	73	1,102	397	998	450	1,132
Mouth of Crawfish river	80	0	93	0	1,899	684	1,720	776	1,951
Fort Atkinson	87	7	97	4	2,290	824	2,075	935	2,354
Above mouth of Catfish river	105	18	108	11	2,615	952	2,396	1,080	2,718
Mouth of Catfish river	105	0	108	0	3,175	1,143	2,877	1,297	3,264
Above mouth of Pecatonica river	135	30	165	37	3,795	1,366	3,438	1,550	3,900
Mouth of Pecatonica river	135	0	165	0	6,403	2,305	5,801	2,615	6,581
Above mouth of Kishwaukee river	160	25	189	24	6,703	2,413	6,073	2,738	6,890
Mouth of Kishwaukee river	160	0	189	0	7,970	2,869	7,221	3,255	8,192
Mouth of Leaf river	173	13	212	23	8,476	3,051	7,679	3,461	8,712
Above mouth of Elkhorn creek	221	48	280	68	8,915	3,209	8,077	3,641	9,163
Mouth of Elkhorn creek	221	0	280	0	9,175	3,303	8,313	3,747	9,431
Above mouth of Rock creek	250	29	307	27	9,330	3,359	8,453	3,811	9,590
Mouth of Rock creek	250	0	307	0	9,543	3,435	8,646	3,897	9,809
Above mouth of Green river	274	24	325	18	9,680	3,485	8,770	3,954	9,950
Mouth of Green river	274	0	325	0	10,811	3,892	9,795	4,415	11,112
Mouth of Rock river	286	12	340	15	10,973	3,950	9,942	4,481	11,279

Table of the tributaries of the Rock river.

River.	Length.	Drainage area.	Discharge per second.		Theoretical power under 10 feet head.	
			Ordinary low flow.	Average flow.	Ordinary low flow.	Average flow.
	Miles.	*Sq. miles.*	*Cubic feet.*	*Cubic feet.*	*H. P.*	*H. P.*
Crawfish river	60	798	287	723	326	820
Catfish river	40	530	191	480	217	545
Pecatonica river	140	2,608	939	2,363	1,065	2,681
Kishwaukee river	50	1,260	456	1,147	517	1,301
Elkhorn creek	40	261	94	236	107	268
Rock creek	45	213	77	193	87	219
Green river	80	1,131	407	1,025	462	1,163

DESCRIPTION OF THE WATER-POWERS.

Taking the water-powers in their order of occurrence from the source to the Mississippi river, the characteristic features of each are as follows, naming also known undeveloped sites:

From the source to Watertown.—On a branch of the river which flows from the west in Washington county, there is a small saw-mill using about 8 horse-power under a head of 12 feet, but with that exception there is no utilized power which can be considered to be situated on the Rock river until Hustisford is reached, 10 miles below the village of Horicon, which is at the old outlet of lake Horicon.

Hustisford.—At Hustisford there are two grist-mills and a saw-mill. In the census returns the grist-mills are rated as using 65 and 90 horse-power under heads of 8 and 7 feet, respectively, and the saw-mill is rated as using 35 horse-power under a head of 13 feet. These are probably greater than the true amounts, as the grist-mills have only two or three runs each.

Second power.—The next utilized power is 22 miles below Hustisford and 5 miles above Watertown, where there is a mill with three runs of stones under a head of 4 to 6 feet, and at Watertown a small saw-mill, which, however, does not appear in the census returns.

Third power.—The next and last power used above Watertown is 1 mile above that place, and is taken by a four-run mill, working under a head of 6 or 7 feet, and probably using 50 or 60 horse-power. All these powers and the remaining three above lake Koshkonong have the disadvantage not experienced by the other water-powers below, of having no artificially-regulated reservoir, and hence must depend largely upon the natural storage of the Horicon swamp for the maintenance of the flow.

The total fall from the village of Horicon to Watertown is 59 feet, of which only 25 feet is in use; for the remaining 34 feet there are probably some sites at which it would be feasible to utilize part, although the river is not considered by manufacturers to offer good sites within this distance.

Unutilized power of lake Horicon.—At the village of Horicon is the now unutilized power which could be formed by throwing a short dam across and renewing lake Horicon.

Mention has been made of the fact that a dam was built there in 1842 and removed in 1868, owing to a decision against the owners, the Merchants' Union Manufacturing Company, because of damages to private land-owners. It is claimed by some interested in the water-powers below, that while this was the ostensible reason of the removal, the true cause was the interest in favor of a land-reclaiming scheme. Be this as it may, the dam gave a head of 9.5 feet of water, and power for some mills which formed the nucleus for the village. With the large reservoir to draw from, the power must have been very steady and have amounted to well toward 500 horse-power.

There is nothing to prevent the renewal of this power, except the large expense resulting from land damages by raising the level of the lake. It would probably be too great for this single power to carry, but if the lake is ever used as a reservoir by the manufacturers along the river, the value of the power here created would be an item in the financial calculation of the project. Mr. Joseph P. Frizell, in his report already alluded to, states that the Merchants' Union Manufacturing Company still owns the greater part of the land that would be overflowed, and assumes in his calculations that this company would release the land in consideration of the water-power that would be created.

Mr. Frizell's estimate of from $200,000 to $300,000 for the land damages is based on a raising of the lake-level 10 feet. This would require a dam not over 200 feet long.

Watertown.—This town, of 7,883 inhabitants, is situated just below the sharp bend in the river from northwest to south. Three lines of railroad connect at this place; the Chicago and Northwestern runs north and south along the river, and there are two branches of the Chicago, Milwaukee and Saint Paul, one passing east and west through Milwaukee and Madison, and the other running northwest from Watertown through Portage City on the Wisconsin, and so to Saint Paul.

The river is 150 or 200 feet wide, with banks sloping gently back to a height of from 10 to 20 feet. It has not worn so deeply into the drift as has been done farther south, but nevertheless the rock has been reached in places, and where the dam is located the bed and banks consist of hard Trenton limestone. The dam is 10 feet high and about 150 feet long, built of framed oak timber. It runs straight across the river.

There are six establishments using the power at Watertown, all under 10 feet head of water. As nearly as can be ascertained from statements made at the place, the powers used are these:

Right or west bank.—Flouring-mill, 110 horse-power; woolen-mill, 40 horse-power; sash factory, 35 horse-power.

Left or east bank.—Custom mill, 44 horse-power; foundery, 20 horse-power; flouring-mill, 150 horse-power.

This makes a total of 399 horse-power, and represents, practically, the total available power of the river, so that without increasing the head there is no more power available at this point, unless reservoirs are created above for regulating the flow.

The following points were gleaned from a conversation with one of the manufacturers: The full power is obtained generally for eight months of the year, and when the fall rains have been heavy there is no difficulty for nine months of the year. In dry times the river is very small, and the mills are largely run by steam-power. When lake Horicon existed they had a good steady power all the year through.

Watertown to Janesville.—The total descent from Watertown to the upper pond at Janesville is 28 feet, and, as there are already three dams taking 17 feet of this, it is evident that the available power remaining undeveloped cannot be very great, and it is stated that none exists.

The first utilized power is 1.5 mile below Watertown, and is taken by a mill with five small "pony" runs, under 6 feet head of water. There is, of course, a large amount of unutilized power at this place.

Jefferson.—The next power is at Jefferson, just above the mouth of the Crawfish river. The slope of the banks is much like that at Watertown, but the river is at least 100 feet wider. The dam is about 225 feet long, and the head is not over 4 or 5 feet.

There is a flouring-mill of four runs of stones, taking 65 horse-power, and a woolen-mill taking 20 horse-power; both are on the right bank of the river. According to the estimates in the table, the theoretical power under the ordinary low flow is 225 horse-power, and there must be considerable power unused.

Outlet of lake Koshkonong.—The dam at the foot of lake Koshkonong, controlled by the manufacturers below for regulating the flow of the river, affords an available head of 6 feet.

There are at present only two small grist-mills using the power afforded by lake Koshkonong, but there has been some consideration by the manufacturers of renting the power.

With a head of 6 feet the theoretical power, under a natural condition of the river, would be from 600 to 700 horse-power, with the ordinary low flow, but owing to the flow from lake Koshkonong being controlled entirely in the interests of the water-powers below the mouth of the Catfish river, there might be a large variation in the amount of power obtainable.

Janesville.—This is a town of considerable importance, with a population of 9,018. There is direct connection with Chicago by the line of the Chicago and Northwestern railroad, running north through Watertown, and branch lines connect with the roads running to Madison, and so west.

There are two water-power levels which may be considered to be situated at Janesville—one in the city, and one about a mile and a half below, in the suburbs.

The upper level.—The upper level is the more fully developed of the two, and is situated in the heart of the business portion of the town. The dam extends straight across the river, just below the crossing of the Chicago and Northwestern railroad, and on the right bank a race runs down-stream 1,500 or 2,000 feet, with eight establishments upon it. On the left bank there is a short race, with only two establishments using water-power. The head used at this level averages 7.5 feet.

The power is owned by the manufacturers, who are not consolidated into a hydraulic company, although there is a desire to bring this to pass, as it would enable them to control the power to greater advantage. Mutual agreements are made as to assessments for repairs, division of the power, etc. When the original improvement was made the power was estimated to be 13,300 "inches" of water under a head of 4 feet, which was the original height of the dam. The power, as estimated on this basis, is divided among the different establishments in the proportions given in the following table. The mills are given in the order of their occurrence below the dam:

Establishment.	Number of "inches" of water owned.	Number of cubic feet per second.	Theoretical horse-power under 7.5 feet head.
Right, or west bank.			
Flouring-mill	2,200	245	209
Cotton factory	4,350	485	413
Flouring-mill	1,700	189	161
Sash factory	450	51	44
Cabinet-shop	400	45	38
Grist-mill	600	67	57
Flouring-mill	450	50	43
Flouring-mill	2,100	234	199
Left, or east bank.			
Feed-mill	450	50	43
Foundery and machine-shop	600	67	57

The right is owned to raise the head to 8 feet. The total power owned under the 7.5 feet of average head is 1,264 theoretical horse-power. The tables give a power, with the ordinary low flow under this head, of about 975 theoretical horse-power. It is evident that the power is all taken up by the existing manufactories. In a low-water year, except extreme ones, they can run at full capacity for nine months of the year, and sometimes for eleven months. In wet years they are not troubled by low water. The wheels are never stopped by back-water, although it sometimes diminishes the power. The dam is about 300 feet long, and consisted originally of brush and timber resting on the gravel-bed of the river. It has been much repaired, and when seen, in the spring of 1881, was in an insecure condition.(*a*)

The lower level.—At the lower level there are four establishments using the power, which has not been so completely developed as that in the town. A race extends down the right bank 1,500 or 2,000 feet below the dam. The head at the dam is about 5.75 feet, and at the end of the race it is 8 feet. With the latter head the power with the ordinary low flow is about 1,000 theoretical horse-power.

The left bank is steep and bluffy, and the only establishment located upon it is a flouring-mill directly at the dam, taking 225 horse-power under a head of 5.75 feet. The right bank stretches away in a broad flat, affording fine opportunities for utilizing the power. At the lower part of the race on this side are a small wheel for pumping water into the water-tank of the railroad, a custom-mill taking about 30 horse-power, and a woolen-mill taking about 40 horse-power under 8 feet head.

Because the power is not fully used there is a large amount of water wasted in the mills, which have old-fashioned wheels. About one-third of the available power is actually employed, and there is plenty of room for the use of the remainder.

The dam was partly carried out in the spring of 1881, but it was the intention to rebuild it. There is at present much contention and litigation in connection with the ownership of the power.

From the lower level at Janesville down to Beloit, a distance of 15 miles, there is a fall of only from 10 to 13 feet, and no available power offers for improvement.

Beloit.—Beloit is situated in Wisconsin, on the east bank of the Rock river, just where it crosses the state line into Illinois. It is a town of 4,790 inhabitants, doing a large manufacturing business, and takes a prominent place

a The dam at the upper level was carried out by the high water of April, 1882.

among the cities of that region. Two lines of railroad intersect at Beloit—the Chicago and Northwestern, running northwest, and the Chicago, Milwaukee and Saint Paul, running southwest. These furnish connection with numerous other lines of road.

The city is on both sides of the river, but the main part of the manufacturing is done upon the west side. This is due to the nature of the topography. In the vicinity of Beloit the river varies usually from 200 to 300 feet in width, but in some places expands to a greater breadth than this. The river-banks are generally comparatively low, but back from the river are the bluffs, sloping back into the general level of the surrounding country.

At the town the river runs near the east bluff, and the bank is high and steep, making it a difficult matter to utilize the power; while on the west the bank is comparatively low, and the land stretches away level for a considerable distance to the rise which bounds the valley.

The dam extends straight across the river just above the town, and a race runs along the west bank for a considerable distance below it, supplying ten establishments with power.

On the east bank there is at present only one establishment, a paper-mill, situated at the dam in a depression of the bank; but there was, in the spring of 1881, a building in process of erection just below it for a manufactory, which was expected to use some of the power.

All the power is owned, and practically all is used, by the manufacturers, who form a chartered company, and whenever expenses are incurred for repairs or other necessary matters, assessments are made upon the members in proportion to the interests held by them.

The first improvement was made in 1842, by the same person who developed the power at the upper level at Janesville, and, as in that case, the original dam was 4 feet high, and the power was estimated to be 13,333 "inches" of water under a head of 4 feet. The head of water now used (spring of 1881) varies from 6 to 8 feet, but averages 7 feet. The charter of the company allows a head of 8 feet, and all damages for flowage due to a head of 7 feet have been paid, as well as part of those for an 8-foot head.

Under the old system of estimating the power on a basis of 13,333 "inches" of water, the mills were drawing more than their portion of the water, because of taking it at a head of 7 feet instead of 4 feet. On this account the power was divided into 800 "shares", each share being equivalent to $16\frac{2}{3}$ "inches" of water under a head of 4 feet, and these shares were distributed among the members of the company in proportion to the number of "inches" held by each under the old contract. Now, one share means one eight hundredth of the flow of the river, whatever that may be. There were some who held "preferred claims", that is, first-right claims, but by these being in part relinquished, and in part bought off, all the powers were placed upon an equal footing.

There are eleven separate establishments, but the ownership of the power is divided among eight different firms and individuals. There is a paper-manufacturing company owning nearly one-half the entire power, and it has a paper-mill on the west bank, besides the one upon the east bank of the river. This company leases 500 "inches" of water (old system) to a machine-knife works, and 340 inches to a foundery.

The following table gives the manufactories in the order of their occurrence on the race along the west bank, and the power owned or controlled by each interest:

Establishment.	"Inches" of water under 4 feet head.	Number of shares owned.
Paper-manufacturing company	6,650	399
Strawboard-paper company	2,000	120
Machine-knife works (*a*)	.....	.....
Foundery (*b*)	.....	.....
Wood-working shop	400	24
Scale manufactory	$183\frac{1}{3}$	11
Flouring-mill	1,100	66
Flouring-mill	1,500	90
Flouring-mill	500	30
Iron-works	1,000	60

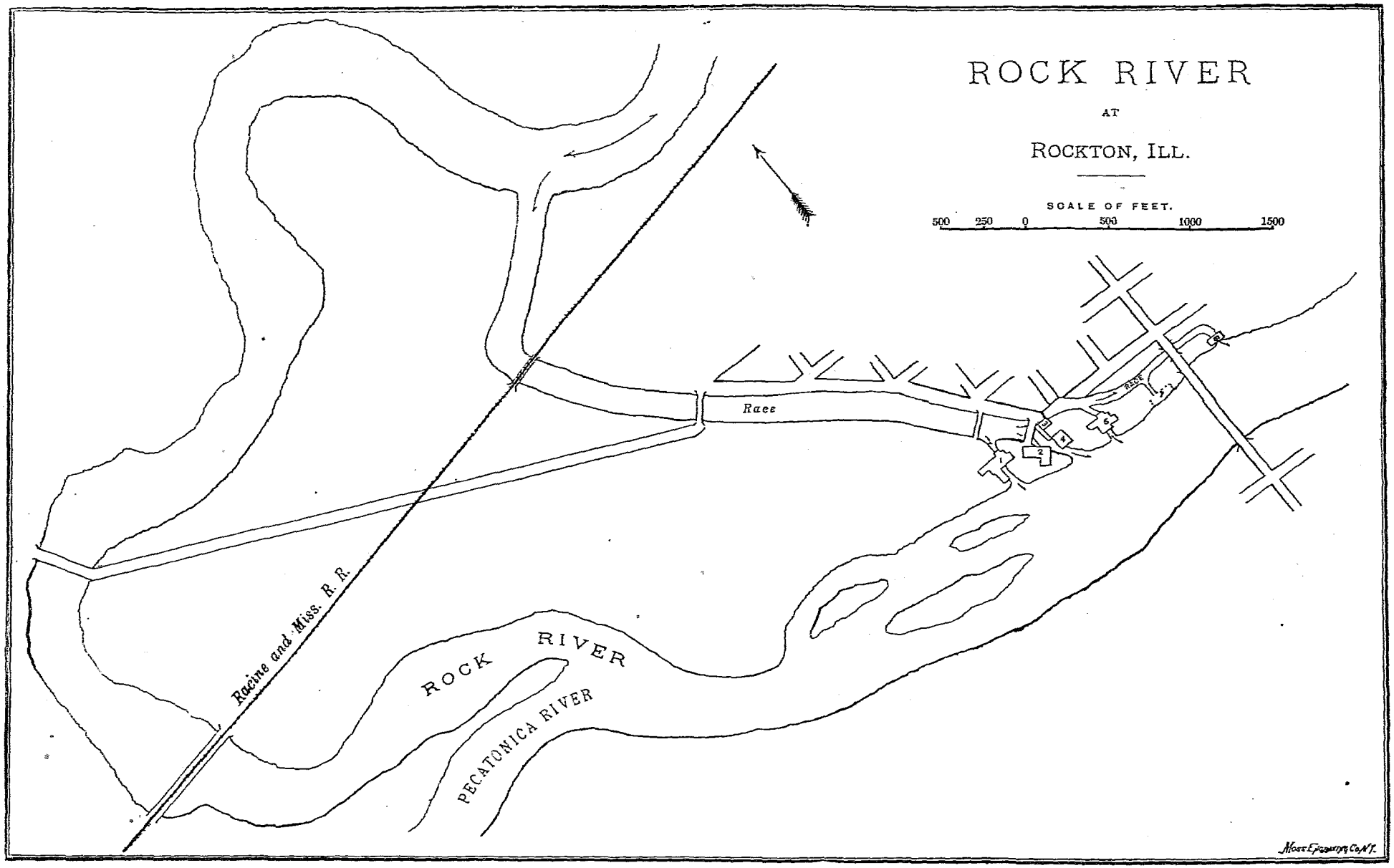
a Leases 30 shares from the paper-manufacturing company.
b Leases 20.4 shares from the paper-manufacturing company.

The paper-mill upon the east side of the river has four Houston turbines under a head of 6 feet, and their total power is rated at 113 horse-power.

There is no difficulty from low water except in unusually dry seasons or cold winters. However, at times economy has to be practiced in the use of the water. The influence of lake Koshkonong is of great value here, as well as at the adjoining powers.

Ordinarily there is no special annoyance from back-water, as the usual rise is only 4 feet, but in the spring of 1881 the water rose 7 feet, and interfered seriously with the manufactories along the race.

The dam is constructed of riprap with a wooden apron on the lower side, and gives a head of about 6 feet, backing the water 5 miles up-stream. The bed of the river is gravel. The dam ran out 250 feet from the east bank,


ROCK RIVER
AT
ROCKTON, ILL.
SCALE OF FEET.
500 250 0 500 1000 1500
Race
Racine and Miss. R.R.
ROCK RIVER
PECATONICA RIVER

and connected with an embankment projecting from the opposite shore. During the high water of the spring of 1881 and the river ran over the embankment behind the abutment, and washed it away, with about 30 feet of the west end of the dam. If the dam had been of wooden frame-work probably it would have all been carried away, but its peculiar construction of riprap acted as a heavy stone embankment. When visited soon after the accident the water was rushing through the break with immense force, in a mass some 20 feet deep, and was constantly wearing the bed of the river. The plan pursued in rebuilding was to throw in heavy square blocks of stone and great quantities of riprap, which were carried some distance by the current, but gradually filled the opening. The overflow was to be increased to 292 feet in length, and the average head raised to the full amount allowed by the charter, viz., 8 feet. This will give a head of 7 feet at the dam.

From Beloit down to the Rockton dam, where is encountered the next developed water-power, there is a total fall of 8 or 10 feet in a distance of about 3 miles. It is practicable to develop a water-power in this distance, but no very good place offers for a manufacturing site. When the railroad company was building its line up the valley, it made an offer to some of the citizens of Beloit of the authority to locate the road if they would improve the power, but nothing was done.

Rockton, Illinois.—At Rockton is the first improved power met after crossing into Illinois. The river makes an extensive bend from south to west, then south, and finally southeast. Just below the western portion of the bend the Pecatonica river, by far the largest tributary, enters from the west, and about half a mile below its mouth is situated Rockton, upon the left bank of the river.

The power is obtained by means of a race 4,325 feet long, which starts from near the upper end of the bend and runs across the neck of land, ending at the river bank 1,000 feet above the highway bridge which crosses the river at the town. From its lower end a smaller race runs down-stream 1,250 feet farther.

There are six establishments using the water-power, of which four are situated at the end of the large race, between it and the river. The power is all owned by the manufacturers, and all in use; if there were any more available, it would be soon bought up by them.

There is no regular water-power company, but the owners have formed an association as a means of preserving their common interests. The power is divided into 96 "shares", held in the following proportions by the different manufactories, given in the order of their position down-stream. The numbers refer to the positions of the buildings upon the map:

No.	Establishment.	Shares.	Theoretical horse-power.
1	Paper-mill	40	560
2	Paper-mill	12	168
3	Machine-shop	2	28
4	Flouring-mill	10	140
5	Paper-mill	28	392
6	Flouring-mill	4	48

At the point marked 7 upon the map there was a flouring-mill which was burnt, and the shares, 12 in number, were sold to the paper-mill, No. 1, bringing their amount up to 40 shares.

The average head on the wheels is 8 feet, and this is obtained by cutting off a distance by the river of about 2.5 miles.

The head of the race is above the mouth of the Pecatonica, and hence that stream adds nothing to the power at Rockton. The flow is practically the same as at Beloit. Using the estimated power at Beloit as a basis for calculation, we find that the flow on which that power was originally calculated is 1,486 cubic feet per second (the ordinary low flow as estimated in the tables for the river is 1,366 cubic feet per second), and this, under a head of 8 feet, gives 1,349 theoretical horse-power. Dividing this by 96, the amount of a share at Rockton at an ordinary low stage must be approximately 14 horse power. The power owned by each manufactory, as given in the table, is calculated with this factor.

Low water does not create any difficulty, except in years of very low water, and lake Koshkonong is looked upon as adding very much to the value of the power. The detriment to the power is the back-water, which is mainly caused by the Pecatonica river. Ordinarily there is more or less trouble each spring, and sometimes in the fall.

The head of water varies in ordinary seasons from 7 to 10 feet. In the spring of 1881 occurred the highest water for at least thirty years. The river rose 10 feet, running over the race embankment and making one continuous sheet of water with it. Thirty years previously to this the water rose to within 9 inches of this height.

From the Rockton level down to Rockford, the next developed power, is 18 miles, and in this distance there is a total fall to the Rockford level of 10 or 11 feet. It is feasible to utilize this fall at a point above Rockford, where a head of nearly 10 feet can be obtained. With the ordinary low flow, a head of 10 feet would give from 2,000 to 2,500 theoretical horse-power. Persons residing in Rockford have had the development of this power under consideration, but nothing decisive has yet been done.

Rockford.—This is the principal manufacturing center on the river, and as it has a population of 13,129 it ranks among the large towns of northern Illinois. The location is upon the west bank. A line of the Chicago and Northwestern railroad runs northwest through the town from Chicago, another line runs northeast from Rockford to Kenosha on lake Michigan, and a short line runs south, crossing the Chicago, Milwaukee and Saint Paul, and connecting at Flagg Centre with other branches of the Chicago and Northwestern. These roads afford ready communication with all the centers of trade, and assist much in the general prosperity of the place.

To a stranger placed in the midst of the manufacturing section of Rockford the impression would be that he was surrounded by a city of manufactories. There are some thirty-two separate establishments using water-power, and these, with their many buildings, storage-sheds, etc., cover a large space. With the exception of three flouring- and grist-mills on the east bank, all the establishments using water-power are on the right, or west bank of the river, which affords the best facilities for developing the power.

The accompanying map shows the plan on which the power is improved. A curved dam, 608 feet long, of cribwork, resting on a lime-rock bed, runs across the river, and from it a short race extends down 285 feet the east bank, supplying the three flouring- and grist-mills before mentioned. On the west bank a race 1,000 feet long and 85 feet wide extends down-stream at a distance of from 200 to 300 feet from the river-bank to within 300 feet of a small stream, called Kent's creek, which enters the river at that place, and from its lower end a smaller race runs up the shore of Kent's creek for 450 feet.

The wheels are situated on the river and creek sides of the two races, and the manufactories are upon both sides of the races, either directly over the wheels or communicating with them by lines of shafting or wire rope. The average head of water is 7 feet, but it averages 6 feet at the dam and 8 feet at the foot of the race.

The railroads facilitate the shipping of freight, and a side-track extends the entire length of the race on the west bank.

Division of the power.—The power is owned by a stock company, and is divided into 20,000 "parts", a "part" being a purely local unit equivalent to one-tenth of a horse-power. The power of the river is held to be 2,000 horse-power under 7 feet head of water, and each member of the company owns his power with that head of water, although the flow of water to which it entitles him may be used under a head of 6 or 8 feet. Assessments are made whenever repairs are necessary, and they average 25 cents per horse-power per annum. The president of the company is Mr. Ralph Emerson. The following table gives the amount of stock and the number of water "parts" owned by each of the nineteen members; the members of the company either use the power themselves or lease it to others, and practically all is now in use:

Name.	Number of shares of stock.	Number of water "parts".	Name.	Number of shares of stock.	Number of water "parts".
D. L. Bartlett & Bros	176	2,200	Frank C. Landers	40	500
Briggs & Enoch	40	500	J. P. Manny	32	400
J. G. Chick	224	2,800	J. Rodd	48	600
T. Dermont	72	900	Rhoads, Utter & Co	128	1,600
William Dyson	32	400	R. H. Tinker	236	2,950
Emerson & Co	112	1,400	W. D. Trahern	32	400
Emerson, Talcott & Co	80	1,000	N. C. Thompson	120	1,500
A. D. Forbes	32	400	Central Furniture Company	24	300
Graham Cotton Mills	80	1,000	Isaac Utter	60	750
W. A. Knowlton	32	400			

The attempt to ascertain personally the amount of power used by each establishment was abandoned, as it was found to be impracticable. The census returns give a total of about 1,500 horse-power in actual use at Rockford, but are compiled in such a form that the amounts cannot be readily assigned to the different manufactories. These are shown in their proper locations upon the map. As before mentioned, practically all the power is now in use, and hence in dry seasons some of the mills are short of water, but they can all run nearly all the time. The Thompson Plow Works have a steam-engine which is used in very low water.

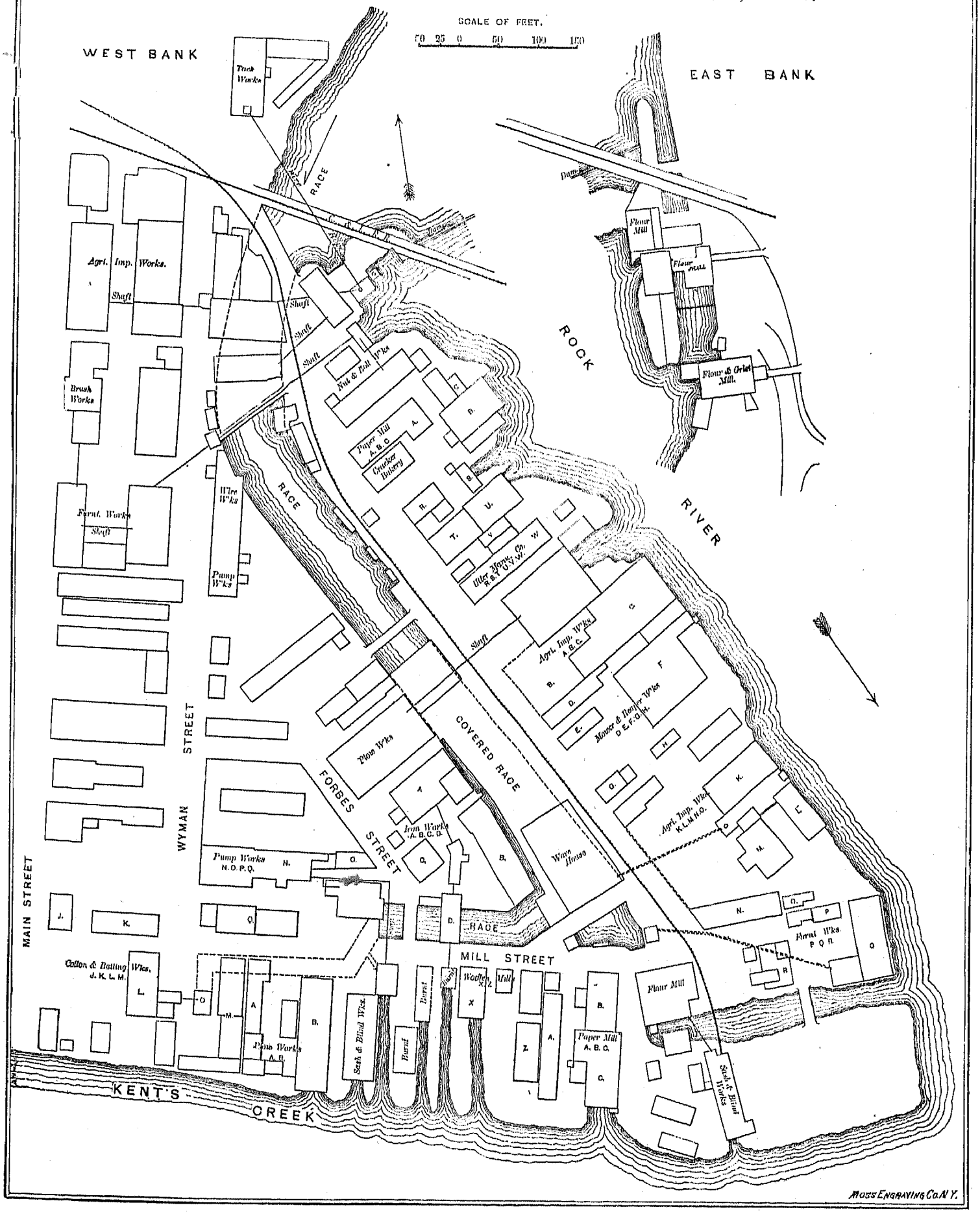
Rockford is the lowest one of the four water-powers which bore the expense of the reservoir at lake Koshkonong. The Pecatonica river makes their power less uniform than the powers above.

There is considerable fall in the river below the race, and back-water gives no trouble except in very high stages of the river.

There is very little chance of increasing the power by increasing the head, for although the river falls rapidly below the race, Kent's creek would prevent the extension of the latter; and because of the existing manufactories it would hardly be lengthened if practicable. The dam cannot well be raised to any great extent because of overflow, and, as it is, damages have had to be paid. The pond extends 12 miles up-stream, nearly to Roscoe.

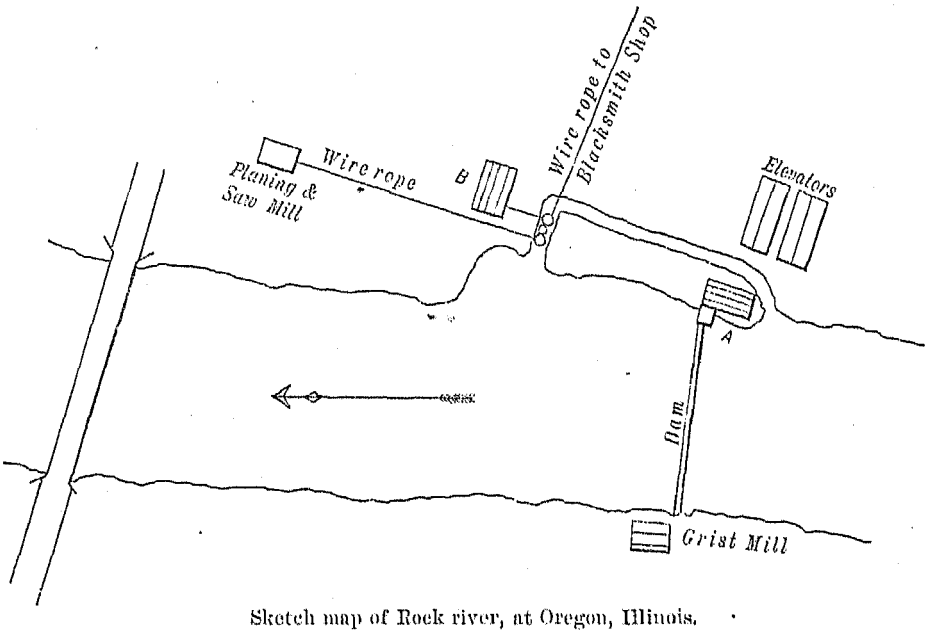
Rockford to Oregon.—From Rockford down to the next improved power, at Oregon, the distance by river is 26 miles, and the total fall from below the Rockford level to the level of the Oregon pond is from 25 to 27 feet. The Oregon pond backs up to the mouth of Leaf river, and the fall from Byron, 4 miles above, is only about 3 feet; hence

MAP OF ROCK RIVER AT ROCKFORD, ILL.



MOSS ENGRAVING CO. N.Y.

over 20 feet of descent occurs in the distance of 16 miles from Rockford to Byron. There are two points at which part of this fall is available. One is about 2 miles below Rockford, where a head of 6 or 8 feet can be obtained without flooding the wheels above, and the other is at Byron, which is at the foot of a rapid that extends up-stream about 3 miles. The water is not broken, but is swift and shallow. A dam has been proposed from which a race would conduct the water through a natural depression across a neck of land, and a head of about 6 feet would be obtained.



Sketch map of Rock river, at Oregon, Illinois.

Oregon.—This village, with 1,088 inhabitants, is situated on the west side of the river. A railroad, known as the Chicago and Iowa, crosses the river about a mile below the water-power, opposite to which the town is situated. A dam extends across the channel of the river, and a short race supplies the manufactories, which are all located on the west bank, with the exception of a grist-mill upon the east bank.

During the early spring of 1881 there were three establishments using the power on the west side of the river: an oatmeal-mill, then a blacksmith-shop and plow factory, receiving power by wire-rope transmission, and last a saw-mill, planing-mill, and feed-mill, all in the same building and run by wire rope. There was a flouring-mill nearly completed, and between it and the oatmeal-mill were the foundations for a paper-mill.

The head of water averages 5½ feet, and it is with this head that the power is calculated. With the exception of 2,000 "inches" owned by the grist-mill on the east side of the river, the power all belonged to Henry A. Mix, and has come into the possession of his heirs, less 3,500 "inches" sold in the following way: 1,600 "inches" to the oatmeal-mill, 1,500 "inches" to the flouring-mill, and 400 "inches" to the saw- and planing-mill. Six horse-power is leased to the blacksmith-shop, at the rate of $75 for the first year and $100 per year afterward. Heretofore the water has been sold at the rate of $4 per "inch" under a head of 5½ feet, but the rate will probably be increased.

The census returns give the power in use by the different establishments as follows: Blacksmith-shop, 16 horse-power; saw-mill, 12 horse-power; two flouring- and grist-mills, 70 and 59 horse-power, respectively. The power is very reliable, as only a small part of it is in actual use, and a large amount yet remains to be disposed of. Races can very readily be run down both sides of the river when required, and the ownership of the land is arranged satisfactorily for this purpose.

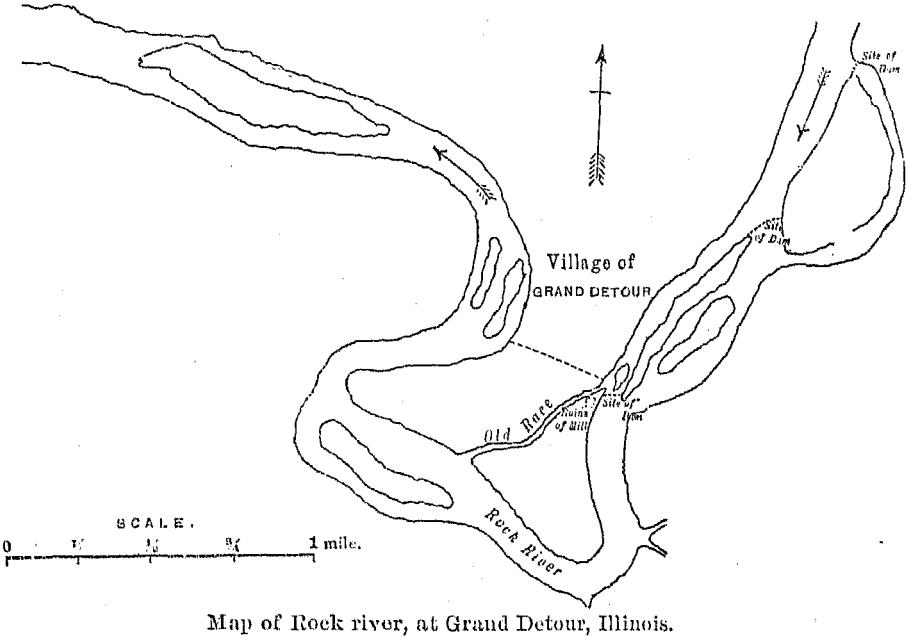
While the head of water is ordinarily 5½ feet, it has at times diminished to 4½ and even 4 feet, owing to low water. The mills have to shut down two or three days during the breaking-up of the ice, but that is practically all the delay they have. Sometimes the ice has gorged below the town and backed the water upon the wheels.

The bed of the river is of gravel, free from clay. This washes out easily, and considerable trouble has been experienced from the scouring of the bed and banks. At one time a part of the dam was carried away and a hole 40 feet deep was worn in the bed of the river. Owing to repeated fillings the bed under the dam is largely an artificial one of broken stone.

The dam was constructed by first throwing in stone until the bed was raised to within a foot of the low-water level, and then the superstructure was built upon this. It consists of courses of logs laid side by side, with their upper branches left on and the butts lying down-stream. A string-piece is laid across the butts of the logs, setting back 2 feet, and on this rests another course, about every fifth log being bolted to the stringer. Broken stone is filled in between the courses.

Oregon to Dixon—Grand Detour.—For the next 23 miles, down to Dixon, there is no developed water-power. There is a total fall of 26 feet, and about 16 feet of this occurs between Oregon and Grand Detour, 14 miles below.

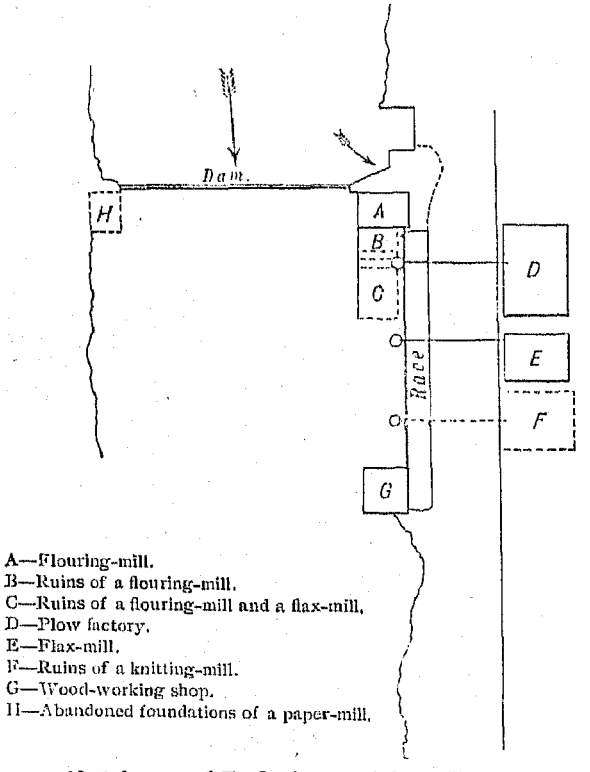
At Grand Detour is met what is probably the finest natural site for a water-power in the entire length of the river The channel makes an extensive bend of about 3 miles, and at its narrowest point the neck of land is only about 1,850 feet wide. By cutting a race across at this point a head of 8 feet can be obtained merely with a dam across one channel to the island shown in the map, while by throwing a dam entirely across the river it is claimed that a head of nearly 16 feet can be used.



Map of Rock river, at Grand Detour, Illinois.

In 1837 a dam and race were built, one or two mills started, as indicated upon the map, and the village of Grand Detour promised to be a place of importance. The location of the railroad line through Dixon diverted population, however, and now there are only 253 inhabitants. The dam was carried out by the water, the race is nearly filled up, and the mills are not used.

No other very valuable power offers between Oregon and Dixon, although it is probable that a portion of the fall below Grand Detour could be utilized.



Sketch map of Rock river, at Dixon, Illinois.

Dixon.—At this town is a developed water-power affording 6.5 feet head of water. All the establishments now using the power, four in number, are located on the left bank of the river, and the wheels are supplied from a race

about 500 feet long, which extends between the river and one of the streets of the town. The dam is about 700 feet long. The owners of the power do not form a company, but co-operate in the maintenance of the dam and other hydraulic works. Only a small portion of the power is in actual use.

The manufacturing industry of the place received a severe check in April, 1880, when most of the mills were destroyed by fire. The manufactories, as they existed in the spring of 1881, were these:

1. A flouring-mill at the head of the race, which had just been rebuilt and started on the ruins of the old mill. This mill draws directly from the pond by a short race of its own, and is also entitled to power from the large race. The total power here owned is 4,000 "inches" of water.

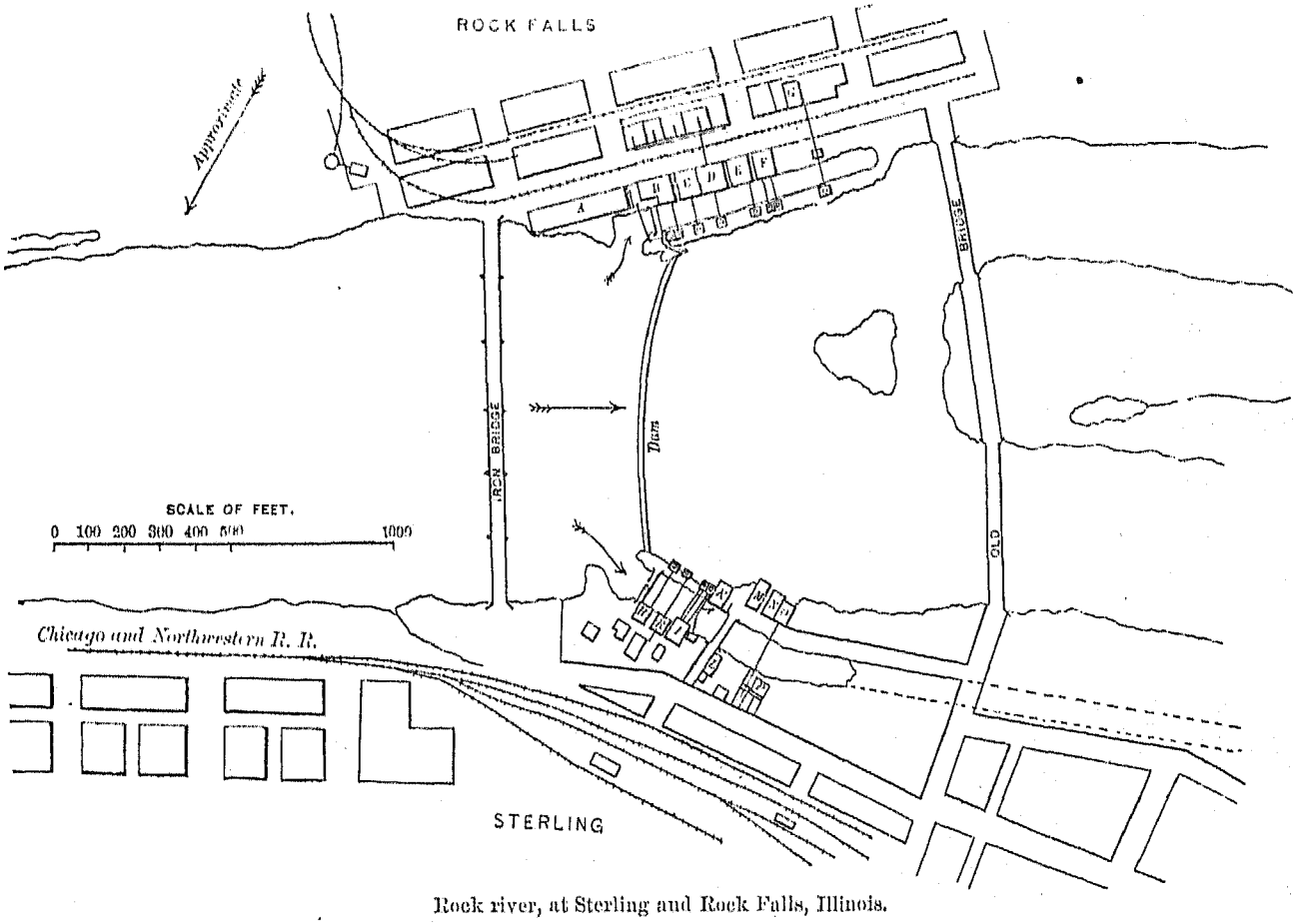
2. A plow factory, using 100 horse-power by means of a shaft running across the street from a wheel on the other side of the race.

3. A flax-mill just below taking 100 horse-power in the same manner.

4. At the foot of the race, and partly built out over the river, are a wood-working shop and a grist-mill, in the same building. The power is owned by the proprietor of the former, and he rents about one-half to the grist-mill. The total is 1,200 "inches" of water.

Just below the large flouring-mill at the head of the race are the ruins of a flouring-mill, and adjoining it are the ruins of a building which contained a flax-mill and a flouring-mill. On the opposite side of the street, below the present flax-mill, is the site of a knitting factory, which also was burnt four or five years ago. Above the plow factory is a foundery, which had a line of shafting extending along the street and transmitting the power to it. This shafting was destroyed during the fire, and was never renewed.

At the extremity of the dam on the other side of the river are some foundations which were started for a paper-mill, but after the outlay of several thousand dollars the project was abandoned because of the expense of the construction on the fine gravel bed.



Rock river, at Sterling and Rock Falls, Illinois.

Power is, of course, never lacking to the manufacturers, because of the small amount used. There are good opportunities for further utilization, and vacant spaces on the present race. There is no physical obstacle to extending the race about 500 feet farther down the river to the highway bridge, but the owner of the land is reported to hold it at so high a price as to have prevented this in the past.

The location is not the best possible one for a dam. The race is partly excavated in solid limestone, and the left bank consists of this, but it sinks rapidly beneath the bed of the river, and the dam is built upon a gravel bed. The construction of the dam is much the same as in the case of that at Oregon—courses of logs and brush weighted

with stone. The top is covered with a double layer of pine and oak planking, to prevent leakage. The first course of logs extends 10 feet beyond the dam and is planked over, forming an apron to protect the gravel bed of the river.

It is said that in the distance of 13 miles from Dixon to Sterling and Rock Falls the banks are generally low, and there is no available power. The total fall between the two levels is about 9 feet.

Sterling and Rock Falls.—Of these two places, Sterling, with 5,087 inhabitants, is situated on the right bank of the river, and Rock Falls, a village with a population of 894, lies directly opposite on the left bank. They are both manufacturing places, and take their power from the pond formed by a dam thrown across the river. An iron highway bridge crosses the stream 400 feet above the dam, and 1,200 feet below is an old bridge crossing at the head of a large island. Still below are several other islands. There is a race on each side, running down from the abutment of the dam.

The natural rapids were about 2 miles long, and the dam is situated a little above the center of the distance, although the greater part of the fall is below. There is altogether on the rapids proper a fall of nearly 15 feet, of which 8 feet is below the foot of the dam, about 5 feet at the dam, and nearly 2 feet in a short rapid just at the head of the slack-water of the pond, some three-quarters of a mile above the dam.

Originally the entire power was owned by the Hydraulic Company of Sterling, and, although no gaugings were made, it was considered to be 30,000 "inches" of water under a head of 6 feet, the height available at the mills. Ten thousand "inches" were sold and guaranteed to Mr. A. P. Smith, of Rock Falls, and the company considers that 20,000 "inches" were left. Of this amount, 8,300 "inches" have been sold, leaving in round numbers 10,000 "inches" yet in the possession of the company.

The Sterling power.—The Sterling race is 600 feet long, 100 feet wide, and about 8 feet deep. There are altogether eight buildings in which the power is utilized. All the wheels are on the river side of the race, and four of the buildings are on the same side; the others have lines of shafting across the race. The following list gives the various industries in the order of their occurrence down-stream, and the number of "inches" of water belonging to each. The letters refer to the positions of the buildings on the maps:

	"Inches".
H and R, machine-shops	1,500
I, flouring-mill	2,500
K, flouring-mill	1,500
L, oatmeal-mill (burnt in 1881)	1,000
M, custom grist-mill and pump factory	800
N, O, and P, Novelty Manufacturing Company	1,000

The Rock Falls power.—The Rock Falls race runs down the bank of the river 700 feet, and is about 75 feet wide. It is close to the river, and all the manufactories are between it and one of the streets of the village, their wheels being on the river bank, and the power transmitted across the bank by shafting. The power is taken by seven establishments, which have bought all the power from Mr. Smith, with the exception of 1,800 "inches". It is distributed among the following manufactures:

	"Inches".
A, Industrial Company (various manufactures)	1,000
B, Keystone Company (agricultural implements)	2,000
C, grist-mill	1,200
D, Northwestern Barb-Wire Company	1,000
E, agricultural implements	1,000
F, grist-mill	1,000
G, agricultural implements	1,000

The last-mentioned establishment is across the street, and the power is transmitted to it by wire rope.

The water-power at these places is reliable, because the mills do not use all the water. They can run all the year without special difficulty, except for a few days. If all the power were used there would be more difficulty from scarcity of water, and a careful gauging of the quantity used by each mill would be necessary. Now each uses whatever is required, as there is plenty of water. Several years ago the river was very low, and some of the mills had to shut down during the day, or run only a part of their capacity.

Ice rarely gives any serious trouble. The channel widens below, so that the water passes off readily, and there is not much difficulty from back-water, although there have been ice-gorges below at times. When the mills at Rockford and above shut down on Saturday night the resulting low water begins to be felt on Monday, and the usual stage is not restored until Wednesday, but this does not prevent the running of the mills.

Unimproved power.—The dam can be raised 2 or 3 feet without flooding land, as the banks are high. There is not much inducement to extend the race on the Rock Falls side, as there is about 200 feet of unoccupied space at the lower end of the race, affording room for utilizing the 1,800 "inches" of water yet remaining.

On the Sterling side there is considerable unoccupied space on the race, and it could be very readily continued down to near the foot of the rapids, obtaining a head of at least 10 feet.

There is an old water channel running parallel with the river, which is often occupied now during high water. The race could be run along the side of this. The entire power of the river could be utilized on the Sterling side.

The dam is an old one, built in 1856. The bed is limestone, and the dam is constructed of crib-work, with an equal batter on both sides. It is 1,000 or 1,100 feet long, and curved up-stream.

From Sterling down to Lyndon, a distance of 18 miles, there is about 25 feet of fall. At Como are some slight rapids. Undoubtedly some of the power could be developed, but there is none utilized, and there are no important localities.

Lyndon.—At this place is a partially utilized power, in a rather dilapidated condition. An insecure dam, 800 feet long, extends across the river, and a race runs about 300 feet down the right bank. There are four buildings, but only two of them use the power; these are a grist-mill, with six runs of stones, and a paper-mill. Below them is a building formerly used as a grist-mill, and another which was started by the Grangers as a plow factory, but failed; the head is 7 feet. The proprietor of the paper-mill ordered a 120 horse-power steam-engine, anticipating the carrying out of the dam in the spring of 1881, and it is said that all the owners of the power would be glad to sell out. There is not sufficient capital available to build a good dam.

The river narrows just below the dam, and hence there is difficulty from back-water in freshets. The bed is a weak sandstone, somewhat liable to shale off when exposed.

Formerly an island stood in mid-stream, and the dam ran to it, but now it is nearly washed away. If the place were developed in a thorough manner, a substantial dam and race built, and everything made complete, the power could be depended upon, and would be of value.

Cleveland.—The next utilized water-power is at Cleveland, about 7 miles above the mouth of Green river. At this place is a flouring-mill, on the east side of the river, with four runs of stones, under 4.5 feet head of water.

The fall from Lyndon to the Cleveland level is approximately 20 feet, and the distance 33 miles. The only prominent power which offers for development is at some rapids about 5 miles below the mouth of Rock creek. An island divides the river into two channels, and by throwing a dam across one of them on the rock-bed of the river a head of 6 feet can be obtained. About 10 feet of head is available by extending the dam entirely across the stream.

From Cleveland down to Milan the opportunities for developing a water-power are slight, and the total descent is not over 8 feet, if as much as that. The Milan pond backs 7 miles up-stream, and the rise from it to the mouth of Green river is only 2.2 feet.

Near the mouth of this stream is a rapid where a small head could be obtained, but if a dam were raised so as to give a good head it would probably flood the wheels at Cleveland.

Milan.—The village of Milan is situated upon the south bank of the Rock river, 2.5 miles from where it enters the Mississippi river. It is a place of 845 inhabitants, connected with Rock Island city and Davenport, a few miles distant, by the Chicago, Burlington and Quincy railroad. At Milan are the lowest rapids of the river, and the last water-power.

As seen from the map the river is divided into three channels, and the middle one of these again divided for a short distance. All, with the exception of the southern channel, unite near the town and flow as the Rock river into the Mississippi, 2.5 miles distant. The southern channel, known as Kickapoo slough, pursues a winding course and empties into the Mississippi 5 miles from Milan. It takes a comparatively small portion of the flow. Of the three islands, Vandruff island, which separates the northern and middle channels, has an extent of 90 acres; the others have only a few acres each. The channels distribute the flow of the river and the power, so as to afford great facilities for its development.

There are in all seven establishments, located upon both sides of the river and on islands Nos. 1 and 2. The islands are not greatly elevated above the river.

The bluffs rise directly from the river on the right or north side, but the south bank, after rising 8 or 10 feet, continues nearly level or undulating for several miles back.

The Rock river was classed as a navigable stream by Congress, and on Vandruff island are the remains of an old canal which the government built to pass the rapids. The canal was of no use and is now empty, except where filled with earth. There were great schemes afloat, when Davenport and Rock Island were small villages, for making a large city at this place, and lots were laid out which have long since disappeared in the river. Daniel Webster is said to have lost several thousand dollars by investments in real estate here.

The ownership of the power is distributed among several individuals and companies. A few years ago there was some difference of opinion regarding the rent of a portion of the power, and a survey was made, resulting in the following figures: The low-water flow is 3,931.5 cubic feet per second. Of this, 2,019.9 cubic feet pass through the north or main channel, and belong to the Rock River Improvement and Navigation Company, consisting of the Sears Brothers, who have their mills on the north bank of the river. The remaining 1,911.6 cubic feet are divided between Mr. D. B. Sears, the Heaks property, and the Johnson property. The Johnsons are entitled to 863.1 cubic feet per second from Kickapoo slough, and their mills are situated on the south bank of the river. Mr. Sears owns 524.25 cubic feet, and the Heaks property the same amount. The last two owners can take their water from either of the channels between Vandruff island and island No. 3.

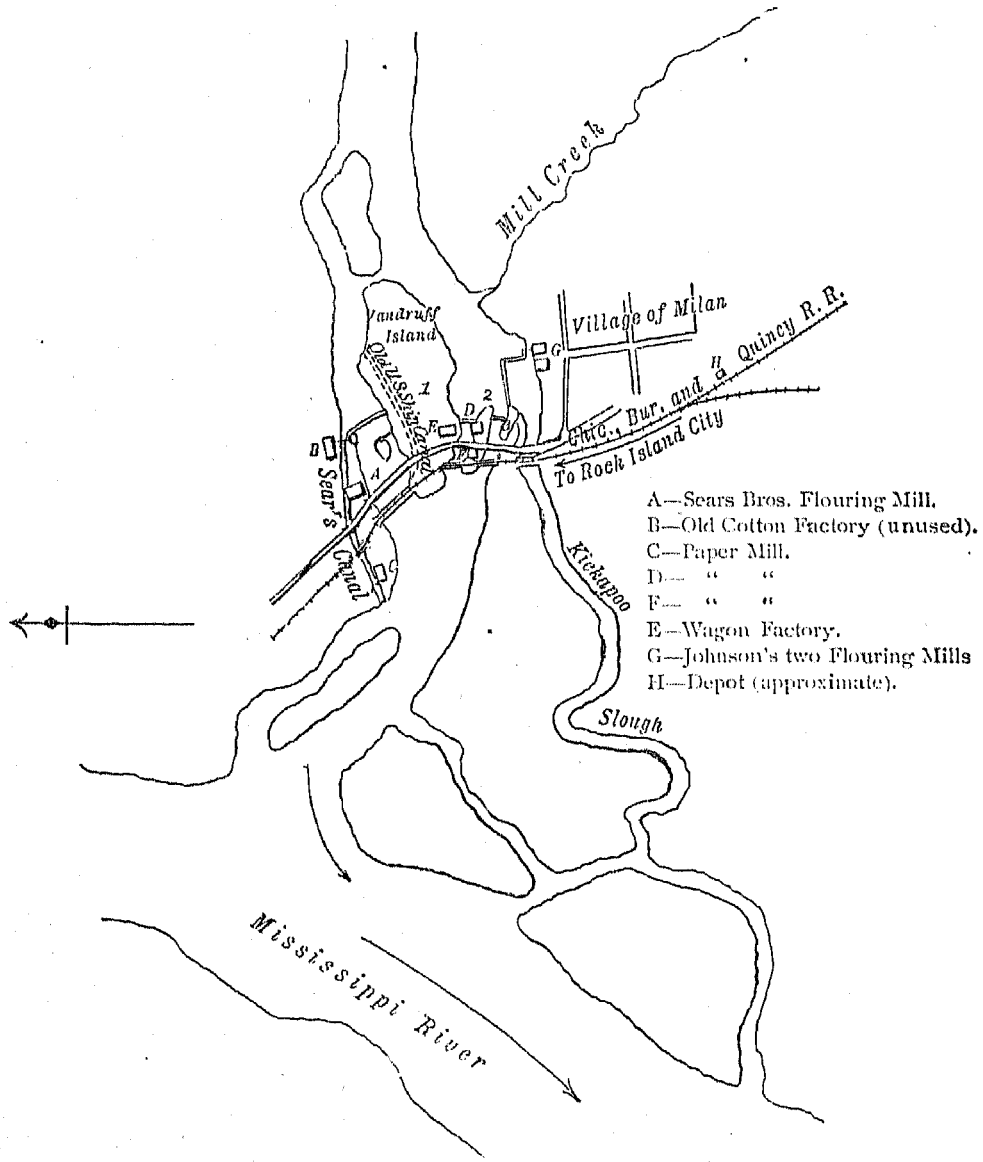
The manufactories are these:

On the south bank are Johnson's two flouring-mills, fed directly from the pond. They use together 150 horse-power under 5.5 feet head of water, but are entitled to a head of 6 feet. Their flow of 863 cubic feet per second under the latter head would give 587 theoretical horse-power.

On island No. 2 are two paper-mills. The one at the lower end of the island is the Heaks mill. It is fed by a canal running along the north side of the island. The canal is 350 feet long, about 32 feet wide, 7 feet deep at the

lower end, and 3½ feet in depth at the upper end. The bed is very uneven, and when the mill is running the water is drawn down and the head much reduced. Ordinarily the head is about 7 feet, and 200 horse-power is used.

The upper paper-mill is situated at the dam, and has a head of 6 feet available. When using the water-power it took about 130 horse-power, but there was difficulty regarding the rental from the Heaks property and steam-power has been substituted.



Sketch map of Rock river, at Milan, Illinois.

On Vandruff island, at the other end of the dam extending between it and island No. 2, is a large brick building erected for a watch factory, but used now as a wagon factory. There is a head of 6.4 feet, and the owners control 600 square "inches" of water at that head.

On the north shore is the power belonging to the Sears Brothers, who are by far the largest owners of the water-power. As previously mentioned, they constitute the Rock River Improvement and Navigation Company.

Because the river is considered a navigable stream by the government, the company was obliged to furnish a navigable channel when it obstructed the natural channel of the river in the improvement of its power. Accordingly it has constructed a canal about 1,700 feet long; 60 feet wide at the bottom, and 7 feet deep in the upper part, and for the remaining distance 40 feet wide at the bottom and 4 feet deep, running along the north bank around the rapids, and provided with a lock, etc., for the passage of vessels. From this canal, which is scarcely, if at all, used for navigation, the water is taken for hydraulic purposes.

There are three buildings on the canal; one large brick building at the head was once a cotton factory, but the machinery has all been removed, and the place is lying idle. The power was transmitted across the canal by a wire rope from the wheel-house, situated directly at the abutment of the dam. A head of about 10 feet is available. Just above where the road crosses the canal is Sears' flouring-mill, with eleven runs of stones under a head of 11½ feet. At the foot of the canal is a paper-mill with 12½ feet head of water on its wheels, and using about 150 horse-power.

Peculiar nature of the power.—With only about 700 horse-power in actual use, and 2,500 available even with the lowest head used, it will be readily seen that there need be no scarcity of water. There is no trouble from low water, but when the power is further developed it will be necessary to define more accurately the flow used by the several companies. As it is now, the mills have to shut down usually two or three weeks out of the year, and this is not due to scarcity of water, but to backwater. One peculiarity is that the Johnson mills upon Kickapoo slough are very differently affected from those on the other channel of the river. This is due to the difference in the channels, and the imperfection in the plan of the Johnson dam and wing-wall.

There is a fall of only about 2 feet from the tail-race of Sears' mill to the Mississippi by the direct channel of the river, and the result is that when the Mississippi is very high it will back up the river and drown the wheels at Milan, with the exception of those of the Johnson mills, which, situated on the slough entering the Mississippi farther down, are not so affected by backwater from the latter stream. On the other hand, when there is a freshet on the Rock river itself, then the Johnson mills are stopped, while the other mills experience little difficulty unless the Mississippi is also high. The reason is that there are 800 feet of overflow on the dam and wing-dam into Kickapoo slough, while the slough contracts a short distance below to about 140 feet in width; hence the water backs up so as to drown out the wheels. However, either of these causes of stoppage acts only for a short time and is not of much importance.

About once in every decade there is an extraordinary rise, when the river backs up very badly upon the mills at Milan. Thus, in June of 1880, boats could be rowed up stream directly over the crests of the dams.

The ice goes out very heavy at times and is likely to injure the dams. Occasionally the mills are troubled by it and slightly by anchor-ice before the river is well frozen over.

Utilized power.—The power could reasonably be developed so that a head of at least 7 feet would be available throughout, and the greater part of the flow could be utilized under a head of 10 to 12 feet. Calling 9 feet the average, the total power would be 4,033 theoretical horse-power. With not more than 700 horse-power in use there remains at least 3,000 horse-power available, for the utilization of which there are excellent facilities.

Without mentioning the opportunities of freightage, with the railroad crossing the river at the foot of Vandruff island, and the ease of communication with the sites by teams, the nature of the localities is such as to recommend their occupation. There are a great number of sites on Sears' canal, with a head varying from 10 to 12½ feet. With their flow of 2,019.9 cubic feet per second, they have 2,520 theoretical horse-power available under a head of 11 feet.

A canal could be run down Vandruff island from the dam across the north channel. There is an unused bulkhead on the canal on island No. 2, and on both islands Nos. 2 and 3 are sites capable of improvement when required. On the south bank of Kickapoo slough a canal could be readily extended for half a mile and good sites obtained. The Johnsons own the river-front above the railroad, and could without difficulty construct the canal.

Dams.—There are four dams at Milan running between the islands, and forming one pond above them, which backs 7 miles up-stream.

The bed of the river is limestone ledge. There are two varieties of limestone—a light gray, which makes a good building stone, and is used for Sears' mill, and a finer-grained, bluish variety, which is very irregular, breaks out in chunks instead of slabs, and disintegrates on exposure. In the bluffs a ferruginous sandstone occurs, and a seam of coal several inches thick.

The dam crossing the north channel is 640 feet long and 12 feet high. It consists of a timber frame, each bent being about 30 feet long. The sill pieces were sunk into the bed of the river. For an apron horizontal stringers were let into the front posts, and planking was spiked to these. The ice cut it away, and then a spar-dam of logs was built into the face of the old dam to act as an apron.

The dam between islands Nos. 1 and 2 is 320 feet long, and that between islands Nos. 2 and 3 is 240 feet long. They have essentially the same construction as that just described, except that the apron is not replaced by the log work.

Connecting island No. 3 with the large island below it is a dike, not overflowed. A wing-dam runs up-stream 300 feet to the Johnson dam, which extends straight across the channel 500 feet to the south shore. This is an old spar dam built in about the year 1855, and leaks badly. It is 5½ feet high and 24 feet broad at the base. Before the Sears' dam was built across the north channel, the Johnson dam extended entirely across to Vandruff island, and the slough was used as a pocket.

TRIBUTARIES OF THE ROCK RIVER.

The branches of the Rock river are less important than would be supposed for a river of its size. The table of tributaries gives the chief ones in their order from the source down, and the data concerning them. The average for the entire basin is taken in calculating their flow, although, as described on preceding pages, such a method can only give a rough approximation.

On the seven tributaries given in the table there is a total of 49 establishments, of which all but five are flouring- and grist-mills, mainly doing merely local grinding. The remaining five are wood-working establishments, saw-mills, etc. There are a number of mills upon the smaller tributaries distributed through the basin. The statistics regarding these powers have been taken from the census returns.

Crawfish river.—The Crawfish is the first tributary of much size below the headwaters of the Rock. It drains 798 square miles, but is a sluggish stream, and has only one utilized power. This is occupied by a flouring-mill, using 80 horse-power under a head of 10½ feet, at Milford, some 10 or 15 miles above the mouth. On the Beaver Lake branch there is a mill using 20 horse-power under a head of 14 feet, at the outlet of Beaver Dam lake, and there are also two woolen-mills, taking 52 and 45 horse-power under heads of 8 and 10 feet. The lake is an artificial one formed by the mill-dam.

Catfish river.—The Catfish river is the outlet of the four fine lakes in the vicinity of Madison, Wisconsin. There are five establishments using the power of the river; four flouring-mills taking a total of 300 horse-power under heads of 4 and 8 feet, and one wagon-shop using 17 horse-power under a head of 7 feet. The principal mill is at Stoughton, with five or six runs, taking 117 horse-power under 8 feet head of water. If the Madison lakes were regulated exclusively in the interests of the water-powers, there would be great regularity in the flow, but they are always maintained at as high a level as possible, and not allowed to be drawn down.

Pecatonica river.—The Pecatonica is the largest branch of the Rock river, and has more improved powers than any other tributary stream. There are eighteen flouring- and grist-mills—mostly small ones—upon it, two wood-working shops, and a manufactory of agricultural implements. The total power used is 688 horse-power, and the heads of water vary from 20 to 4 feet.

The largest mill is at Freeport, in Illinois, and has five runs of stones, taking 130 horse-power under a head of 5 feet. There are also at Freeport a three-run mill and a small wood-working shop. They are not especially troubled with scarcity of water, but it is not probable that any more mills could be accommodated in dry seasons.

At Freeport the river is from 130 to 150 feet wide, with low rim-banks of earth, and these characterize it for a large part of its course. The upper portion is in the "driftless area", in Wisconsin, already described. The Sugar river, an important tributary draining about one-third of the basin, enters from the north, some 7 miles from the junction with the Rock river. There are eight establishments upon it, all flouring- and grist-mills, using 317 horse-power under from 6 to 12 feet head of water. The largest mill takes 120 horse-power under a head of 10 feet. Along the lower part of the stream especially, the bed and banks are inferior for dams and other hydraulic works, and in places are almost a quicksand.

Kishwaukee river.—The Kishwaukee drains 1,266 square miles. Ten or 12 miles above the mouth it divides into the North and South branches, the North branch draining rather more than half the basin. The entire amount of power used is 179 horse-power, taken by six flouring- and grist-mills and one small saw-mill. The head varies from 4 to 14 feet. There are two grist-mills on the South branch, each with two runs of stones.

There is a two-run mill at New Milford, on the main river below the junction, and the remaining three mills are on the North branch; a three-run mill at Cherry Valley, a four-run mill at Belvidere, and a two-run mill at Garden Prairie, with only 4 feet head of water. There are no mills on the river above this.

The Kishwaukee is 150 or 200 feet wide at Belvidere, some 10 miles above the junction with the South branch. It is not a very rapid stream, and the banks are generally low. It ranks among the average rivers of this region as regards freshets and low water.

Piseasaw creek enters the Kishwaukee river just above Belvidere. There are four mills upon it, all using two runs and from 6 to 9 feet head of water, with the exception of the one at the mouth. This is called the "Good Thunder mill", the name of a celebrated Indian chief, and is fed by a race leading from the creek to the Kishwaukee river, giving a head of 12 feet. There are three runs of stones and a set of rollers.

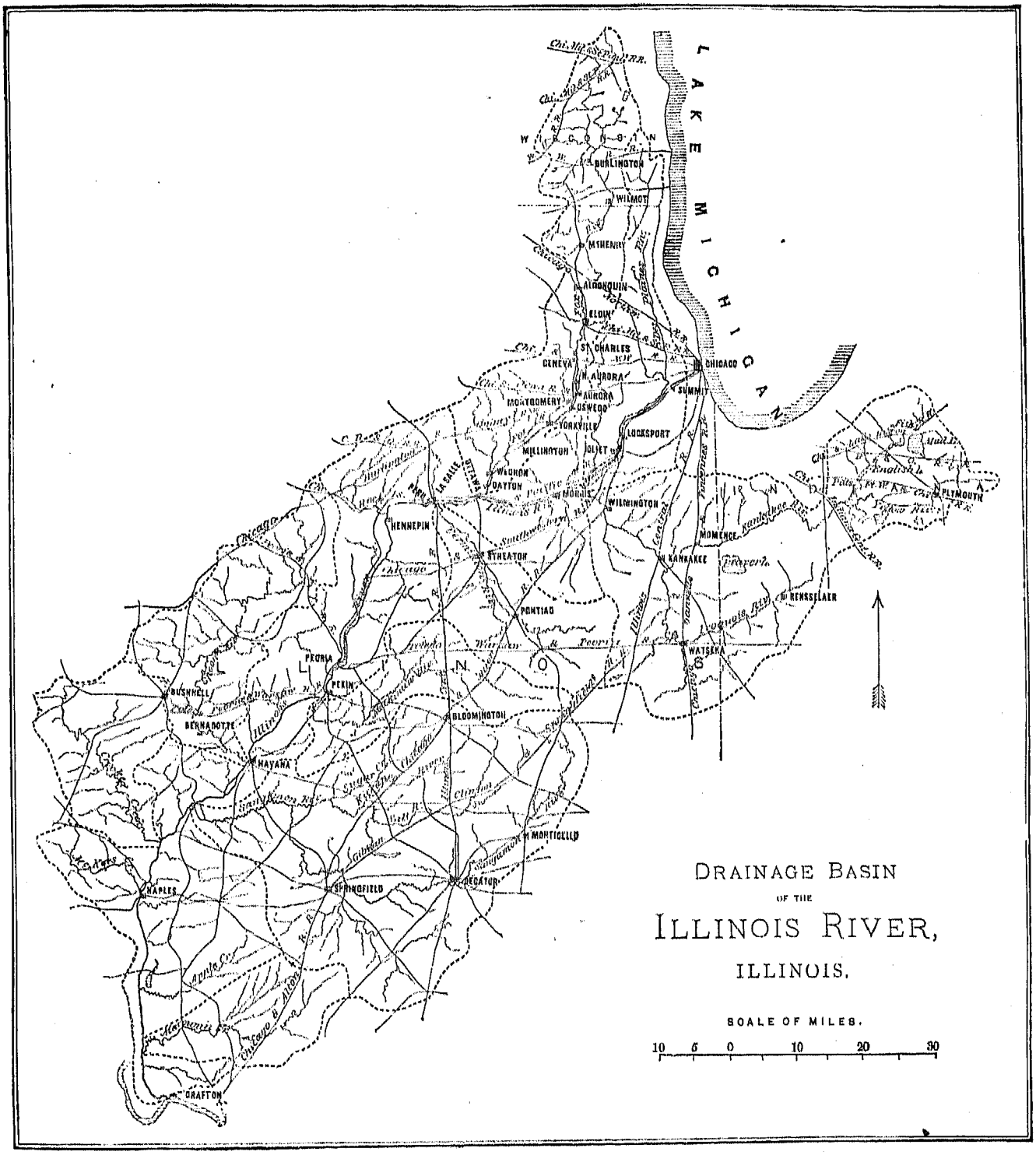
Elkhorn and Rock creeks.—The Elkhorn and Rock creeks are minor streams, each with several small custom mills upon it. At the mouth of Elkhorn creek, at Como, there was, before the time of railroads in that region, a flouring-mill which was among the first in the state in importance. The water was brought in a race across a point of land from the creek to Rock river.

Green river.—Although Green river drains an area of 1,131 square miles, there are no developed water powers upon it. At one time there was a small mill at Oakley, 6 or 7 miles from the mouth, but it is not now used. The basin of the river is swampy, and it is a sluggish stream, with low banks, poorly adapted for water-power.

TRIBUTARIES OF THE EAST SIDE OF THE MISSISSIPPI, FROM THE ROCK TO THE ILLINOIS RIVER.

The distance by the Mississippi, from the mouth of the river just described to the junction with the Illinois, is 267 miles, and although the Iowa, the Des Moines, and several other streams of more or less importance enter from the west, no tributaries of noteworthy size join the Mississippi between the points named in Illinois. This is owing to the position of the divide between the Illinois basin and the Mississippi; it passes within from 10 to 20 miles of the latter river for four-fifths of the distance from the Illinois to the Rock, and then recedes, so as to leave a strip averaging about 40 miles across.

In this section are three streams, Edwards river, Pope creek, and Henderson river, which merit a passing notice.



DRAINAGE BASIN
OF THE
ILLINOIS RIVER,
ILLINOIS.

SCALE OF MILES.

10 5 0 10 20 30

The land is decidedly undulating and the soil is rather light for wheat, but better adapted to the raising of corn, which is the chief crop. There is a large amount of timber scattered over the region, including elm, oak, hickory, sycamore, and also black walnut; but a large part of this was bought up in the winter of 1880-'81 and shipped to Saint Louis.

Henderson and Edwards rivers are the largest of the three streams, and Pope creek merely drains a narrow strip between them. They all appear to be average streams as regards regularity of flow, not true prairie streams, but yet subject to considerable freshets. The bed and banks are chiefly earth, and often low, so that dams back the water over the land, but in some places the bed is cut to the rock.

Pope creek is rather more rapid than the other two, which do not have much fall and are more or less subject to back-water during high stages.

Edwards river.—There are three mills on the Edwards river; one, about 7 miles from the mouth, with a head of 5 feet and two runs of stones; one at Millersburg, with a head of 7½ feet and two runs, and one at Opheim, with a head of 8 feet and two runs. In addition to these are some undeveloped powers. North of Viola there is a good power, with a head of 7 feet, at which there was once a mill, but the owner tore it down rather than pay further damages for flowage. Between Aledo and Viola there was once a carding-mill, with 7 feet head of water.

Pope creek.—Pope creek has only two developed water-powers; one, about 6 miles from the mouth, where is a mill with a head of 6 feet and two runs of stones, and another, south of Aledo, with a mill using the same number of stones under a head of 8½ feet. These mills can run eleven or twelve months of the year. There are several unutilized powers. At a point 1 mile or 2 miles below Suez is a privilege with a head of 6 feet, where was a carding-mill several years ago.

Henderson river.—There are two mills on the main Henderson river. Jack's Mills is a small settlement just east of Oquawka. The flouring-mill at that place has three runs of stones under a head of 9 or 10 feet. A part of the year the mill cannot be operated, on account of scarcity of water, but at times there is more power than required. About 3 miles below Cedar creek is a mill with three runs under 12 or 15 feet head of water.

The South Henderson, which joins the main stream about half way between Oquawka and its mouth, is small, but has a rapid descent. There are also two mills on Cedar creek and one on Fall creek, both of them tributaries of the Henderson.

THE ILLINOIS RIVER.

At a distance of 1,180 miles from the source of the Mississippi, and 24 miles above its junction with the Missouri, the Illinois enters from the east, the most extensive of all the tributaries of the upper Mississippi.

Its drainage area of 29,013 square miles is distributed among three states: 24,726 square miles are in Illinois, and extend in a broad band, 250 miles long and averaging 100 miles wide, directly across the center of the state in a northeast direction. From the upper extremity of this band are two projections—one north into Wisconsin, and comprising 1,080 square miles in that state; the other east into Indiana, and including 3,207 square miles of its northern portion.

The eastern projection is the basin of the Kankakee river, while the northern one forms the basins of the Fox and the Des Plaines rivers, and it is the union of the drainage of these projections which may be considered the origin of the Illinois. The name is applied to the river from the junction of the Kankakee and the Des Plaines. Its course is from 20 to 40 miles from the line of water-shed on the northwest, and 60 to 80 miles from that on the southeast.

Character of the country.—The region drained by the Illinois is level or undulating, and includes some of the finest land of the United States. The broad strip across Illinois embraces the greater part of that deep rich loam which has made the state so prominent for agriculture. Corn is the staple crop; winter wheat is grown, but wheat-raising is not so pre-eminently the industry as in Minnesota; the soil is lighter and better adapted to corn. Grazing is very extensively carried on.

The fertility of the basin and its position with reference to the lines of communication have led to its early settlement and prosperity. Except in swamps and extreme points, the country is pretty thoroughly under cultivation. The population is about 1,038,000, and numerous large towns and cities are interspersed along the river and its tributaries. Prominent above all others is Chicago; strictly speaking not within the limits of drainage, its influence has been most pronounced in the development of the surrounding country, and largely to the presence of this great center of trade are due the manufacturing industries to be found. The development of the water-powers of the Illinois basin is more or less the result of the phenomenal growth of Chicago, coincident with the topographical relations; and later will be shown the relation of the available powers to this city.

With so many thriving towns, it is unnecessary to say that the railroad facilities are excellent. A net-work of roads covers almost the entire basin, and many of them are "through lines" between the East and West.

The river itself is an important channel of trade. Like the Fox and the Wisconsin rivers of Wisconsin, the Illinois and the Des Plaines river, which passes so near lake Michigan, offer great advantages for navigation from the great lakes to the Mississippi, and ever since the French commander La Salle made the portage and descended the Illinois it has been used as a channel between the two great water routes.

A canal 100 miles long, called the Illinois and Michigan canal, starts from lake Michigan at Chicago, and cutting through the low summit enters the Des Plaines River valley. Crossing the river at Joliet it runs along the right bank of the Illinois to Peru, where it enters the river, and from there to the Mississippi, a distance of 230 miles, there is navigation, partly natural and partly artificial slack-water, caused by two dams—one at Copperas creek, 130 miles above the mouth of the river, and one at Henry, 190 miles above the mouth.

The construction of a canal 65 miles long from Hennepin, on the Illinois river, about 20 miles below the terminus of the Illinois and Michigan canal, to the Mississippi at Rock Island has been much discussed. The cost is estimated at from four to four and a half million dollars. A feeder is also talked of, starting from the Rock river at Dixon and connecting with the canal, and to be navigable.

System of drainage.—Because of the form of the basin, the drainage into the Illinois is quite evenly distributed along its course. Running, as it does, much nearer the northwestern than the southeastern line of water-shed, there are more important tributaries entering from the left than from the right bank of the river. The three principal streams are the Sangamon, the Kankakee, and the Fox rivers, the first two of which are on the left side of the main river.

The chief tributaries, given in their order from source to mouth, are these:

RIGHT BANK.		LEFT BANK.	
Stream.	Drainage area.	Stream.	Drainage area.
	Sq. miles.		*Sq. miles.*
Des Plaines river	*a* 1,758	Kankakee river	5,302
Fox river	2,607	Vermillion river	1,413
Spoon river	1,905	Mackinaw river	1,182
Crooked creek	1,280	Sangamon river	5,502
		Macoupin creek	1,000

a Approximate.

The total area drained by these nine tributaries is 22,135 square miles, leaving 6,878 square miles to be drained by the smaller streams which flow into the Illinois all along its course.

As previously mentioned, the Illinois proper is formed by the junction of the Kankakee and the Des Plaines rivers, starting off from the first with a tributary area of over 7,000 square miles; 33 miles below it receives the Fox river, the Mazon river and Aux Sable creek entering above it; then the Vermillion, 15 miles below, near the terminus of the canal. About 90 miles below the mouth of the Vermillion the Mackinaw enters, but in the intervening distance are several important creeks, as Big Bureau, Sandy, and Kickapoo. Next is Spoon river, about 20 miles below the Mackinaw; then the Sangamon, 20 miles below; then Crooked creek, about 15 miles below the Sangamon; and finally, Macoupin creek, about 18 miles above the mouth of the river and 65 miles below Crooked creek. Between the last two streams mentioned are McKee's creek, Mauvaise Terre creek, Apple creek, and several others.

Although the drainage area is quite uniformly distributed along the length of the basin, the utilized water-power, and almost all the available power, is confined to the upper portion. The census returns show a total of only 782 horse-power utilized below the Fox river, by thirty small mills averaging 26 horse-power each, the largest taking 64 horse-power.

Practically all the utilized water-power of the basin, amounting, according to the census returns, to 10,144 horse-power, is located on the main river and canal above the mouth of the Fox at Ottawa, on the Fox itself, the Kankakee, and the Des Plaines. The water-power of the Illinois basin is thus included within a radius of 60 miles from Chicago from west to south. The Fox, Des Plaines, and Kankakee rivers, including an area of 10,000 square miles, descend from a table-land into the valley of the Illinois, with rapid descent over rocky beds, and give rise to extensive water-powers, easily developed.

The through lines of railroad between Chicago and the West and Southwest cross the rivers or run along their valleys, and the canal stands ready for the manufacturer's use. As might be supposed, the power is largely used for general manufacturing suited to the wants of a large population, and is not devoted very exclusively to any special branch of industry.

The northern limit of the coal-fields of Illinois is in this region, and these add to its natural wealth and development. It is largely to the existence of the rich beds of coal in the basin that is due the undeveloped state of the powers, such as they are, which exist on the lower tributaries. In the early history of the state, before coal was so cheap, there were many grist- and saw-mills on the Sangamon, the Vermillion, and other streams, but from the difficulty of maintaining dams, the increasing unsteadiness of the streams as the country was cultivated, and the cheapness of coal for fuel, these were gradually abandoned, and now few remain. Owing to the unpromising character of these rivers, except in favored localities, and the ease of obtaining fuel, there is no special inducement to develop the water-powers, and probably all this portion of Illinois will remain practically dependent upon other than hydraulic-power for its manufacturing.

Flow of the streams.—The average rainfall of the Illinois basin is 37 inches per year, nor does it vary far from this amount in any part except south of lake Michigan, where an entirely local increase, caused apparently by the proximity of the lake, raises the annual precipitation to about 45 inches over a large portion of the basin of the Kankakee.

Although a fair amount of moisture falls upon the basin, the Illinois dwindles to a small stream in the dry season. In the tables and remarks concerning the tributaries of the Mississippi this has been already dwelt upon. There is no way of accounting for the extremely small "ordinary low flow" of 2,000 cubic feet per second, estimated by the United States engineer in charge, except by the very level and prairie character of so much of the basin in Illinois.

The Sangamon, and in fact all the streams below the Fox, fall to a very low stage in summer and fall, the water all passing off in heavy freshets, sometimes of several weeks' duration. There are few swamps, lakes, etc., to hold the water back, and the well-nigh universal testimony is to the increasing fluctuations of the streams since the draining of swamps and the clearing of the land. Nor is the Fox to be entirely excluded from the category of "low-flow" streams. Rising among some lakes of Wisconsin and northern Illinois, the summer flow is maintained rather better than in the case of the streams just mentioned, but still it falls away in dry seasons, and the gaugings of the United States engineers place its flow (presumably at a low stage) at 526 cubic feet per second, or 0.195 cubic foot per second per square mile.

The Des Plaines is a stream much resembling the lower tributaries in character of flow, but it is constantly fed by an average discharge from lake Michigan, through the canal, of 373 cubic feet per second, an item of no small moment to a stream naturally draining only about 1,758 square miles.

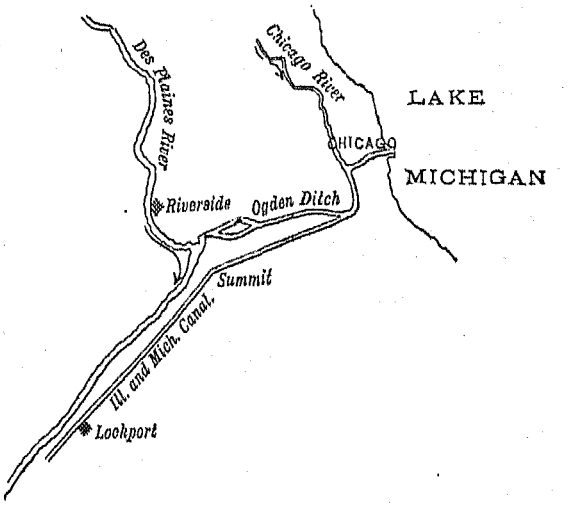
The Kankakee is to the Illinois basin what the Wisconsin, Chippewa, and other similar streams, are to the upper Mississippi. Swamps characterize its entire course in Indiana, and these, with the lakes, serve very materially to maintain the flow during summer and fall. Engineers familiar with the river estimate the ordinary low flow to be 1,300 cubic feet per second, or 0.245 cubic foot per second per square mile. This appears low, but it must be remembered that its large tributary, the Iroquois, flows mainly from a level or rolling prairie, and is an unsteady stream.

Enough may be gathered from the preceding remarks to make it evident that the most steady drainage of the Illinois basin is in the upper part, where the developed water-powers are situated, and most fortunate is it that such is the case; for, if the Kankakee and the Fox dwindled in summer to shallow brooks falling over their rocky beds, the otherwise fine powers would be of little value.

The average flow of 373 cubic feet per second through the canal from lake Michigan plays an important part in the water-powers along the canal and the Des Plaines river.

POWERS ON THE CANAL, AND ON THE DES PLAINES AND THE MAIN RIVERS.

Relation of the rivers, canal, and lake.—Because of the relation of the canal to the Des Plaines, and then of both to the Illinois itself below the mouth of the Kankakee, it seems most advisable to start from Chicago and pass down the canal and the Des Plaines river to the junction with the Kankakee, and then down the main river, describing the water-powers in order as they are met with.



The Des Plaines river rises in Wisconsin and flows nearly parallel with the lake Michigan shore to a point about 10 miles southwest of Chicago; it then turns southwest, and flows 40 miles to the junction with the Kankakee. In this distance the valley averages about 1 mile wide, and consists of a rather shallow trough cut out of limestone. This is only scantily covered with a thin bed of drift, and the banks of the river are consequently very low. The canal starts from the lake at Chicago and crosses to the river at Summit, 11 miles from the city. It then passes down the left side of the Des Plaines for 25 miles to Joliet, where it enters the river, and then crosses to the right bank.

From Joliet down to La Salle it runs along the right bank of the Des Plaines to the Illinois, and along the bank of the Illinois river. A feeder, 4 miles long, starts from the "state dam" on the Kankakee river, and supplies the canal with water, and one of the same length takes water from the Fox river at Dayton, and enters the canal at Ottawa, at the junction of the Fox and the Illinois rivers. There are also the Calumet feeder, near Chicago, and others of no importance to this report.

The summit between the lake and the Des Plaines valley, in the vicinity of Chicago, does not exceed 20 feet in elevation above the lake, and the canal, which formerly passed this by a lock, now goes through the "deep cut" excavated from 6 to 10 feet in the limestone.

From the lake down to Lockport, a distance of 32 miles, there is now a continuous level, with a fall of 3 feet in the water surface. The bottom line of the canal is 6 feet below the surface of low water in lake Michigan. The canal really enters the lake through the Chicago river, a small stream. The Ogden-Wentworth ditch, called by some the south branch of the Chicago river, connects the canal with the Des Plaines near Summit.

The Des Plaines, Ogden ditch, and the canal are nearly on a level, and hence the direction of the flow depends largely on the height of water in the river, and the level of lake Michigan. When the Des Plaines is high it flows through Ogden ditch into the lake, and also down the canal. A strong north wind will increase the flow from the lake into the canal, while a south wind may so diminish it as to interfere with the water-powers below.

The average depth of water in the canal at Bridgeport, near its mouth, is 9 feet, and with this depth the flow from the canal is 375 cubic feet per second.

Distribution of fall and power.—The total fall from the level of lake Michigan down to the Illinois at the foot of the canal below La Salle is 141 feet, and half of this occurs in the distance of 18 miles from Lockport, on the Des Plaines, to the junction with the Kankakee. The distance from the Kankakee to the foot of the canal is 51 miles.

There is 50 feet fall concentrated in the 4 miles between Lockport and Joliet.

The total descent of the Illinois from the foot of the canal to where it enters the Mississippi at Grafton is only 33 feet. This portion of the river was formerly under the control of the state, but now Major Lydecker, United States engineers, stationed at Chicago, has charge of it. He proposes to build two slack-water dams in addition to the two now existing; one at La Grange, with 7 feet 4 inches lift, and one at Kampsville, 30 miles from the mouth, with 7 feet lift. These will render the navigation of the river practicable at all times.

These remarks upon the levels of the canal and river will serve to give a general idea of the distribution of the water-powers.

The canal belongs to the state of Illinois, and the policy is to lease power from it where there is a favorable locality and sufficient surplus over the flow required for navigation. As a consequence there are a number of utilized powers upon the canal. The ordinary rate of leasing is $200 per annum for 40 horse-power, in quarterly payments in advance.

The localities of utilized power on the canal, Des Plaines river, and Illinois river, in the order of occurrence, are these:

Place.	Distance from summit.	Remarks.
	Miles.	
Lockport	21	Power from the canal.
Joliet	25	Three levels. Canal enters the Des Plaines and power from the river.
Channahon	36	Power from the canal.
Aux Sable	42	Do.
Marseilles	66	Power from the Illinois river.
Ottawa	73	Power from the Fox River feeder.

These powers vary in importance and extent. Channahon and Aux Sable have only one or two small mills each, while the others are manufacturing points of more or less importance. There are some mills taking water from the Fox River feeder, where it leaves the Fox river at Dayton, but they strictly come under the head of the Fox River powers, and will be so considered.

Lockport.—At Lockport is the beginning of the rapid descent of 50 feet in the 4 miles down to Joliet, and here is the first lock met with after leaving Chicago. The rapid descent in the Des Plaines river begins half a mile above Lockport.

The canal passes along the east side of the valley, several hundred feet from the river. The power is entirely taken from the Chicago level of the canal, and the water from the wheels runs into the Des Plaines river. The average available head is 19 feet, and from measurements made in 1872 Mr. D. C. Jenne, the engineer of the canal, estimated the average flow available for water-power to be 352.65 cubic feet per second, giving 760 theoretical horse-power. Norton & Co., of Lockport, rent the power from the state, and sublease a portion of it to the different manufactories.

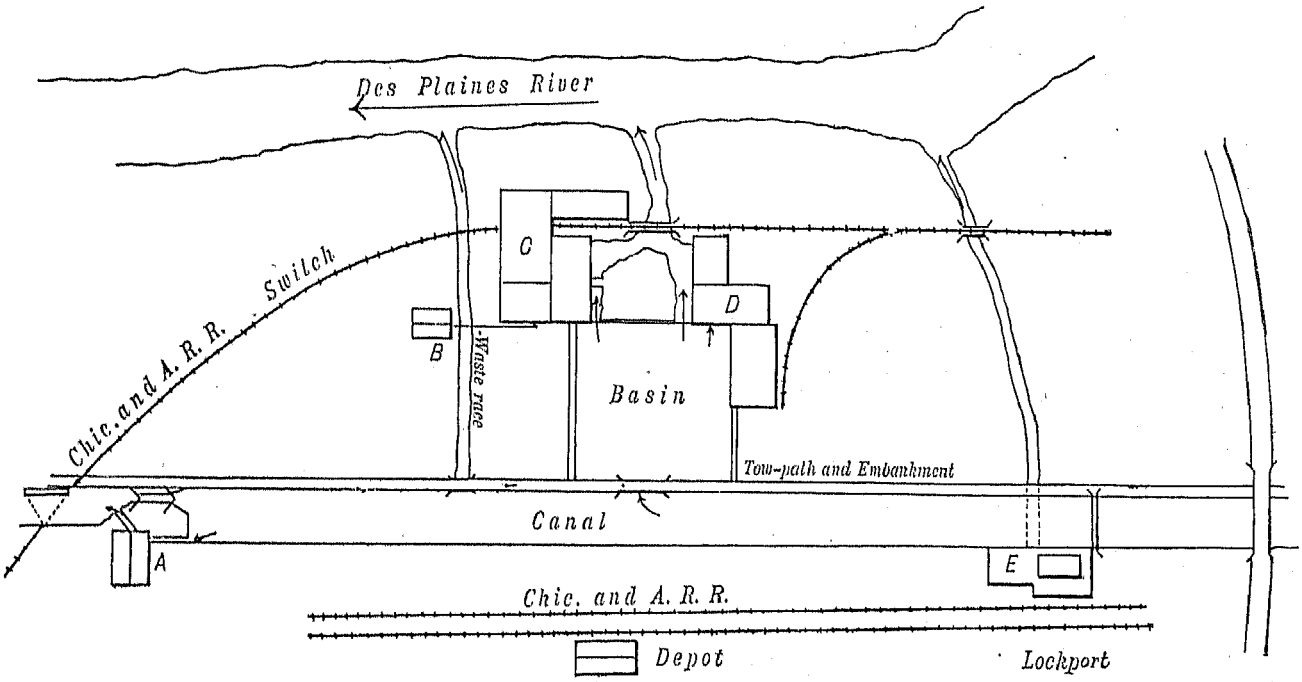
There are four establishments taking the power, of which two are situated at a basin about 300 feet square, fed from the canal. On the north side of the basin is a flouring-mill, and on the south side a paper-mill, from which a wire rope transmits power to a building used for preparing the straw.

Some distance above the basin, and on the other side of the canal from the river, is a building used for a grain elevator, a planing-mill, a machine-shop, and to contain the pumps for supplying Lockport with water. At the lock below the basin is a small tannery, using the fall at the lock. The tail-race for the elevator passes under the canal and through an excavation in the limestone to the river.

The limestone here is a superior quality for building; the Joliet quarries, 4 miles below, are noted. The flouring-mill has a capacity of 700 barrels per day, and the paper-mill a capacity of 20 tons per day. The latter

uses 200 horse-power, under a head of 18 feet, the same head that is used by the flouring-mill. The elevator, etc., use 175 horse-power, under a head of 16 feet, and the tannery about 20 horse-power, under a head of 8 or 10 feet.

The head available varies from 18 to 20 feet. The manufactories cannot draw so as to lower the head much beyond 18 inches, as that would interfere with navigation, and consequently when the lake is low they have to shut down; but there is not so much difficulty arising from this account as from low water due to freezing. A thick layer of ice, by diminishing the water-way and increasing friction, sometimes so diminishes the flow as to stop the mills. The flouring-mill cannot usually run in winter over half its usual power. Norton & Co. pay a rebate to the manufactories whenever they are stopped by lack of water more than thirty days of the year, but this has never been paid for low water of summer alone. There is very little anchor-ice, and back-water does not stop the mills, although high water in the Des Plaines is not accompanied by a corresponding rise in the canal.



Sketch map of the mills and hydraulic basin at Lockport, Illinois.

It is evident that there is little, if any, available power remaining on this level of the canal with the present flow. At times, however, there is a large volume of water flowing through the waste-weir into the river.

Power on the Des Plaines.—About half a mile below Lockport is an old grist-mill, on the Des Plaines river, with four runs of stones, under a head of 8 feet. The improvement was made in 1838, and there was once a saw-mill also. The dam is 400 feet long, built of stone, resting upon the limestone bed of the river.

Unutilized power, Lockport to Joliet.—As the surplus water of the canal is taken at Lockport there is no unutilized power on it above Joliet, where it enters the Des Plaines river. On the river itself there is no utilized power above the one just described. It is a very unsteady stream, and its power is of very little practical value above where the surplus from the canal is discharged into it at Lockport. The surplus from the canal is considered to have doubled the natural average flow of the river.

Of the 50 feet of fall from half a mile above Lockport down to Joliet, only 8 feet are in use. It is possible to improve the power, but the banks are very low, and a dam giving a good head would have to cross extensive flats.

The limestone strata furnish excellent foundations for buildings.

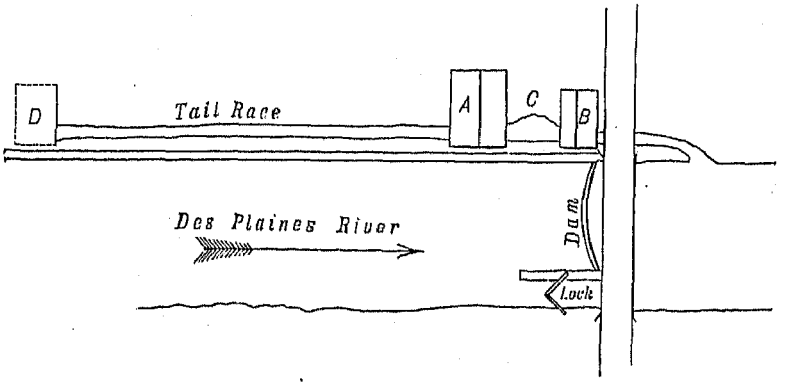
Should the flow through the canal be largely increased, as is contemplated, it would supply, with the 50 feet of fall, a large amount of power; and this could probably be more cheaply utilized from the canal than if the flow were discharged into the river at Lockport and then taken.

Joliet.—Joliet is a town of 11,756 inhabitants and is touched by several important lines of railroad. The Joliet Iron Works are situated there, and these, with several other manufacturing establishments using either steam- or water-power, render it an important manufacturing place.

The total fall of the river within the city is about 25 feet, and this is divided into three levels by 3 dams, of which the upper two belong to the state, and the third to one of the citizens. The canal enters the river in the upper level; the line of navigation then passes the upper dam by a lock into the middle level, from which the canal starts down the right bank of the river.

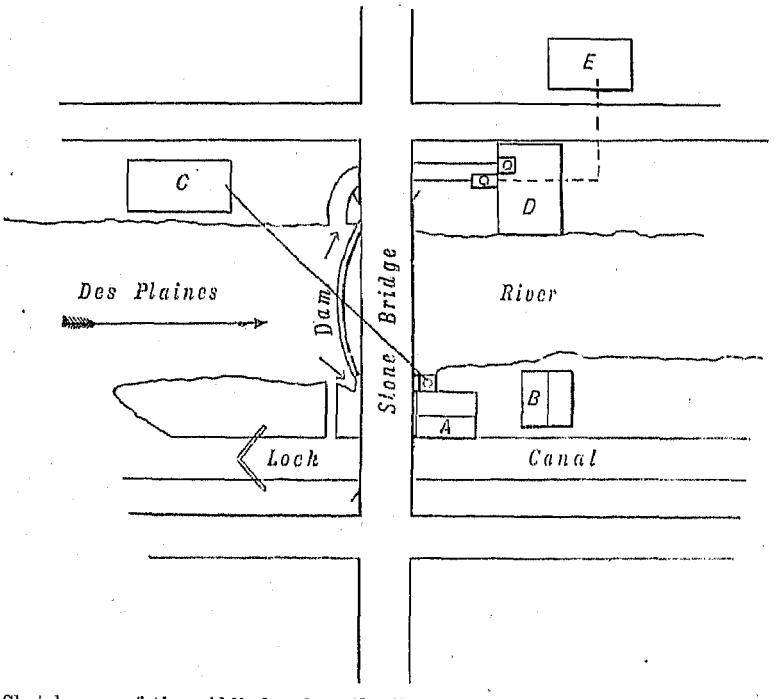
Upper level at Joliet.—At the upper level a levee extends 2,000 feet or more up the left bank from the dam, and behind this are the mills, with a tail-race running along the foot of the levee and entering the river a short distance below the dam.

The power is rented from the state by a Mr. Hyde, who sub-lets part and uses a portion himself, paying the state $1,480 per year. He has practically the entire flow of the river and canal, because the amount required to work the lock is small. Mr. Jenne calculated the total power available to be 258 horse-power under a head of 9 feet. But little of the power is in use; there is a wire-works just at the dam, using 45 horse-power under a head of 12 feet, and paying $1,000 per year rent, and Hyde's flouring-mill, with six runs of stones under a head of 12 feet. Several hundred feet above the flouring-mill a paper-mill was being built in 1881, which was expected to use a 60-inch and a 30-inch wheel, each under a head of 7 feet.



Sketch map of the upper level on the Des Plaines river, at Joliet, Illinois.

There is no difficulty from low water, and generally none from back-water, but in the spring of 1881 there was an extraordinary stoppage of ten or twelve days from the latter cause. There is abundance of space along the embankment for the further development of the power; fully 1,000 feet are vacant. Between the wire-works and the flouring-mill is a vacant lot which is reserved by the state.



Sketch map of the middle level on the Des Plaines river, at Joliet, Illinois.

Middle level at Joliet.—The power of the middle level is rented from the state by Mr. Henry Sanger, and sub-let by him. The total power was estimated by Mr. Jenne to be 196 available horse-power under a head of 7 feet of water. The head used at the manufactories is 6½ feet. The power is practically all in use.

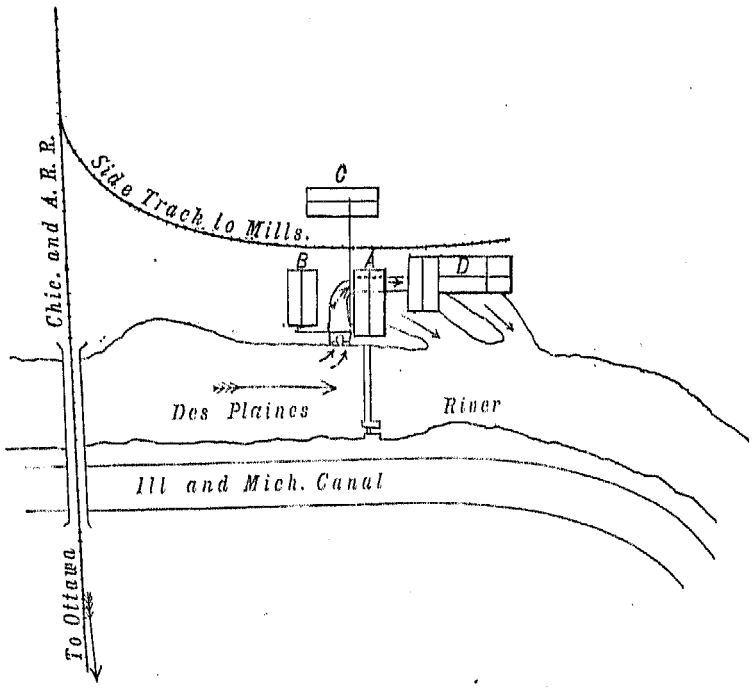
On the right bank, just below the stone bridge which crosses at the dam, are a wire factory and a sash and door factory, taking power from the same wheel-house, which also transmits power by wire rope to an elevator on the left bank of the river, above the bridge. They use altogether 54 horse-power. Below the bridge on the left bank are a foundery and machine shop, using 20 horse-power, and a wire factory, taking 75 horse-power, by shafting from a wheel set at the bulkhead of the foundery.

The masonry dam is about 200 feet long, and curved with a center ordinate of 15 or 20 feet. The bed and banks are of excellent limestone.

Below the dam there is a low rocky island of small size, covered in high water. The lower level backs up, it is claimed, 18 inches upon the wheel of the machine-shop and foundery, and very high stages of river must occasion some difficulty from back-water.

Mills on the canal.—The canal starts from the right bank just above the dam, and skirts the shore of the river. On this there are three manufactories a short distance below the lower dam, described below. They are:

1. A tile company, leasing 60 horse-power; 2. An oatmeal-mill, leasing 100 horse-power; 3. A flouring-mill, leasing 100 horse-power, all under a head of 6 or 7 feet. There is room for many more mills along the canal, but the further use of the water in this way would interfere with the power of the lower level, as is already the case, and will probably not be attempted.



Sketch map of the lower level on the Des Plaines river, at Joliet, Illinois.

Lower level at Joliet.—The water-power at the lower level was developed previously to the opening of the canal, which took place in 1848. The power is owned by Mr. W. J. Adams, and originally included only the natural discharge of the river. By the opening of the canal and the mills at Lockport a large increase was made in the flow of the stream below that place. Mr. Adams claims that the state releases all further right to what water is discharged into the river at Lockport, and cannot divert from the riparian owners below the middle level at Joliet.

The state claims that it can so divert the flow which it artificially introduces into the river from lake Michigan. The erection of the mills on the canal below the middle level was the occasion of a lawsuit, in which the judge of the circuit court decided against Mr. Adams. The case has been appealed.

Mr. Adams' power is very greatly benefited over its original condition by the surplus from the canal. The head of water averages 5 feet 10 inches, and the power is utilized on the left bank by the wire-works establishment of Mr. Adams, using 50 horse-power, and a paper-mill below, leasing 60 horse-power, at an annual rental of $1,100, but using only 40 horse-power. Mr. Adams claims that he has 30 horse-power yet to lease, which would have to be transmitted by cable or shafting.

There is some difficulty, not very serious, during low water, when the canal takes a large part of the flow. Three feet is an extreme rise in the river; with a 2-foot rise the head available is 4 feet.

The dam is a straight stone structure, 200 feet long, 6 feet 10 inches wide at the base, and 3 feet wide at the crest.

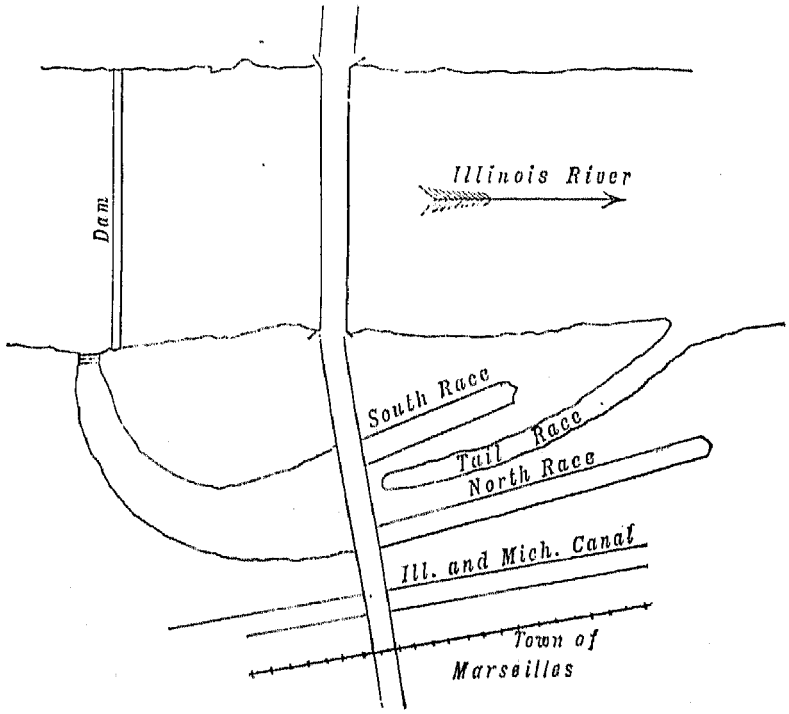
Channahon and Aux Sable.—At these places are the only powers taken from the canal between Joliet and Ottawa. At Channahon is a grist-mill with a head of 7 feet, and leasing power for two runs of stones; and at Aux Sable are a saw-mill and a stave and barrel factory, each leasing 40 horse-power under a head of 6 feet 9 inches.

Unutilized power, Joliet to Marseilles.—There is only one point on the canal between these places at which surplus water is available for power, and that is Morris, 17 miles above Marseilles, where the surplus is probably sufficient to give 75 or 100 horse-power under 10 feet head.

Upon the Des Plaines river there are two available powers below Joliet. The first is 2 miles below the city. By a dam 200 or 250 feet long and a moderate amount of levee, on a good limestone bed and banks, it is claimed that 6 feet head can be obtained without backing upon the wheels of the lower level at Joliet. The facilities are good for building a race.

Two and one-half miles below Joliet is Joliet lake, an expansion of the river, 6 miles long and from 1 to 1½ mile wide. The second power is at the foot of the lake, where there are rapids, and a head of at least 6 feet available. The site is 1 mile from the railroad; the bed and banks are of rock, the latter 8 or 10 feet high at the river, and affording good facilities for constructing races. There would be required about 200 feet of dam and 150 feet of levee on each side.

From here down to the junction with the Kankakee there are no powers of value upon the Des Plaines river, and the same is true of the Illinois river, down to Marseilles, which can boast the only developed water-power on the stream.



Sketch map of Illinois river, at Marseilles, Illinois.

Marseilles.—The town of Marseilles has 1,822 inhabitants, and is situated upon the right or north bank of the Illinois river, 27 miles below the junction of the Kankakee and the Des Plaines. The railroad between Chicago and Rock Island passes through the town, as also does the canal.

The north rim-bank of the river is about 10 feet high, and back from this stretches a level flat for a quarter or half a mile, upon which the town is laid out. The land upon the south side of the river appears much the same, but somewhat higher.

The facilities are excellent for utilizing the full power. All now used is taken on the north bank, between the canal and the river. A timber dam 700 or 800 feet long extends from bank to bank and backs the water into a race, which divides below the bridge into two, a "north head-race", and a "south head-race", the latter being the shorter of the two.

There are five manufactories on the north race and three upon the south race. The head is approximately 9 feet at all, but at the end of the race it is about 10 feet. The tail-race is excavated between the two head-races.

The power was developed by a hydraulic company, which started with a capital of $500,000, and afterward issued bonds for $85,000 more. The company failed to pay either interest or principal, and so the bondholders placed the matter in the hands of a receiver, Mr. J. N. Chappelle, of Marseilles. It is likely that the property will all come under the control of the bondholders.

The total power in use in the spring of 1881 was 490 horse-power, distributed as follows, in passing down stream:

North head-race.	Horse-power.
Oatmeal-mill	120
Agricultural implements	60
Pearl-barley mill	35
Paper-mill	100
Agricultural implements	50

South head-race.	Horse-power.
Paper-mill	60
Paper-mill	65
A paper-mill in process of erection with a contemplated power of 125 horse-power.	

The paper-mill which was under construction in the spring of 1881 had the privilege of leasing 400 horse-power at the rate of $10 per horse-power.

Only a small part of the total power is in use. It is considered that 3,000 horse-power are available for ten months of the year, but in August and September the river is usually too low to furnish that amount. There is an old cofferdam at the head of the race, much obstructing the flow, but it is felt that if that were removed from 1,000

to 1,500 more horse-power than is now in use could be supplied with the present races, and there is no reason why these should not be made more extensive. There are a number of vacant lots upon the races as they now exist. The south race runs out to the river bank, but the north race could readily be continued down-stream for a considerable distance.

When the improvement of the river at Ottawa, which will be shortly described, was made, the Marseilles company, fearing that the water would be set back upon its wheels, ran a small race half a mile down the end of the north race, and built there an organ factory with a head of 18 feet, not now running. It is said that the Ottawa level backed up about 8 inches upon the wheel of the organ factory.

The Marseilles pond now backs up about 22 miles, but it is thought that the dam could be raised 2 feet higher if required. This would give a head of 11 or 12 feet at the mills.

There is no difficulty of any consequence experienced from back water, as the river does not rise over 6 feet at this place. Occasionally there is trouble from cake-ice on the dam, the apron of which was badly broken up in the spring of 1881. The dam is of timber, with stone filling, and the foundation rock generally of good quality, but soft in places, where it wears out. There is litigation now pending concerning the right of certain lessees to sublet. They supply some other industries by means of shafting from wheels on their own premises, and the company claims that they have no right to subrent their power.

Unutilized power, Marseilles to Ottawa.—On the canal there are two locks at Marseilles, having a total lift of 16.7 feet, but there is no surplus water for supplying mills, and the same is true down to Ottawa, where the Fox river feeder enters.

Upon the Illinois, between Marseilles and Ottawa, is a good undeveloped water-power. About the year 1870 a company was organized for the improvement of an undeveloped power on the river at that place, the city of Ottawa subscribing $60,000. A mile above the mouth of the Fox river is an island in the middle of the channel. A dam was thrown across from this island to both shores, and a race cut across the point of land to the Fox river, which also had a dam thrown across near its mouth. From the right bank of the Fox river it was the intention to run a race down, taking the flow of both streams and obtaining about 16 feet head of water. The scheme was a good one, but the dams were very poorly constructed and were soon destroyed by the floods and ice, the company became bankrupt, and the property remains unused. It is now held by a trust company of Newark, New Jersey.

Since the canal feeder takes the greater part of the low-water discharge of the Fox river, it would hardly be profitable to include that stream in any proposed improvement now, but a dam could be thrown over the Illinois at the old site and a race run down the north bank, giving a head of 16 feet and about 3,500 theoretical horse-power during ordinary low water. Taking the statement made at Marseilles as a basis, there is 5,300 theoretical horse-power available at this place during ten months of the year. To get a head of 16 feet it would be necessary to back the water up nearly upon the Marseilles power, 6 miles above.

At one time it was proposed to redevelop this power and utilize a portion of it for a flint-glass factory. The incoherent Saint Peter's sandstone furnishes a deposit near Ottawa of remarkably pure white quartz sand, which is extensively shipped for glass making. Freighted to Pittsburgh, Pennsylvania, it costs $6 or $7 per ton, while it can be delivered at Ottawa for 65 cents per ton.

Ottawa.—Ottawa has 8,000 inhabitants, and is situated on the right bank of the Illinois, just below the mouth of the Fox river. The water-power is obtained from the Fox river by means of the Fox River feeder of the canal.

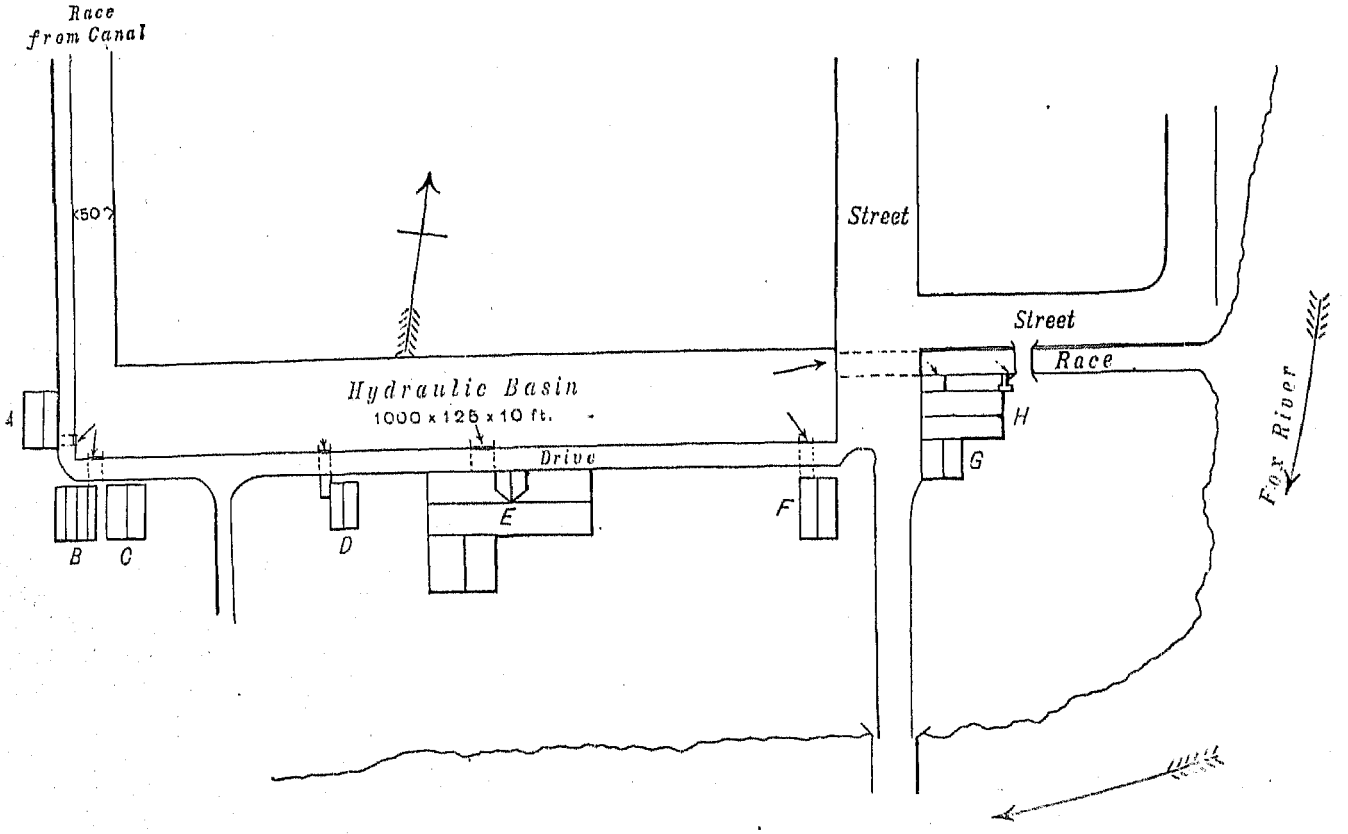
Four miles from Ottawa and a third of a mile above the village of Dayton, a state dam is thrown across the Fox river, and the flow partly diverted into the feeder, about 50 feet wide, which enters the canal at Ottawa. Below the entrance of the feeder, a race about 50 feet wide conducts the water from the left bank of the canal to a hydraulic basin 1,000 feet long, 125 feet wide, and 10 feet deep, lying parallel with the river and several hundred feet away from the bank. On the east the race is terminated by the street leading to the highway bridge, but a small race, 15 or 20 feet wide, passes under the street and extends east 300 feet or more to the bluff at the mouth of the Fox river, where the water escapes through a weir and falls over the rocks to the river below. Along the river side of the basin and race are located the manufactories, discharging their water through tail-races into the Illinois. The river bank of the basin is built up of earth, with a well constructed inside wall of masonry, and serves as a drive-way for access to the various buildings. The flumes for the wheels pass under the drive-way.

Nature of ownership.—The power is controlled by the La Salle County Manufacturing Company, chartered about the year 1850. The company obtained possession of the power in this way: A Mr. Green owned the right shore of the Fox river at Dayton and one-half the flow of the river. When the state built the "feeder", Mr. Green surrendered half his share, or one-quarter of the flow of the river, for canal purposes, the state maintaining the feeder and dam, and furnishing him his one quarter flow free of charge. Then the La Salle County Manufacturing Company obtained the one-half flow of the river unused, and the surplus from the feeder over what was required for working the canal, paying now for the latter $750 rent per year.

The company leases building-lots, and leases its power in divisions called "runs", a run being the power necessary to drive one run of stone and its machinery, and equivalent, as nearly as can be ascertained, to about 18 horse-power. It is not considered by the company that a total of more than thirty runs can be supplied, although

the available head is from 33 to 35 feet. The terms of lease are various, but the price averages from $200 to $250 per run per annum. The powers are distinguished as first-, second-, and third-class runs. The state has a first right to the water, and the canal must be kept full even if the mills have to shut down.

First-class runs are entitled to power as long as there is any surplus from the feeder, while second-class runs are required to shut down if there is not more than enough surplus from the feeder to turn all the first-class, and so on with the third-class. There are six first-class, nine second-class, and fifteen third-class runs. The company has no right to convert any first class into second-class runs, but when a lease expires it can transfer a run of one class from one locality to another, always keeping the total number the same.



Sketch map of mills and hydraulic basin, at Ottawa, Illinois.

The agreement has been made in the leases that the company shall not be responsible for failure of the power provided it maintains the race and basin up to a limit of thirty days per year. If the manufactories have to shut down beyond that time, then a proportionate amount is deducted from the rent.

There are eight or ten runs remaining to be disposed of, two of them first-class runs. Abundance of space yet remains on the basin and the race for the complete development of the power. When there is a fair stage of water the running of all the mills at full power has no effect upon the head, and ordinarily there could be much more power used than is now the case.

The manufactories using the power are as follows, proceeding from the west to the east end of the basin; the powers stated are only approximate, owing to the difficulty of obtaining satisfactory information:

1. A flouring-mill, now closed; it had three runs, under a head of 18 feet.
2. A small flouring-mill, now closed.
3. A brick and tile manufactory, using 30 horse power, under a head of 23 feet.
4. A box factory, belonging to the starch factory, and using 80 horse-power, under a head of 23 feet.
5. A starch factory, using 175 horse-power, under a head of 23 feet.
6. A sash and blind factory, using 40 horse-power, under a head of 21 feet.
7. A flouring-mill, using about 80 horse-power, under a head of 33 feet.

No. 5 leases power amounting to ten runs. No. 7 has the finest power, controlling six runs, of which four are first-class.

East of No. 7, along the small race, were two or three mills, which were burnt down about 1875. At the extreme end of the race was a flouring-mill leasing three runs, one of them first-class.

The water-power may be considered a nearly constant one, the number of days when the mills shut down not averaging over fifteen or twenty for the entire year. There are three ordinary causes for the diminution or entire failure of the power:

First. About the middle of November, and again about the 1st of April, the water is shut off at Dayton, and the feeder is cleaned out, an operation that takes four or five days at each time, and during it all the mills are shut down.

Second. Sometimes the water is so low that the mills have to shut down entirely or in part; for they can only use the surplus after the canal is supplied. This affects the third and second classes, and then the first class. It very rarely occurs that there is not enough water for the six first-class runs, but when it does so occur, then the manufacturers agree upon an equitable division of the time of running. Sometimes in summer the water is low and the mills are impeded, but this is quite as liable to occur in winter, when no boats are navigating the canal. The feeder is long, and if ice becomes very thick the flow is much impeded; moreover, the flow of the river is often small in winter. In the severe winter of 1880–'81 there was a break in the feeder, and, the water being shut off, the ice fell to the bottom and froze fast; then when the water was turned on more ice was added to that below, until there was little space for the flow, and the mills were very seriously impeded.

Third. During very high water in the river it backs up into the tail-races, and tends to diminish the power, but never destroys it.

The maximum head available when the river is at an ordinary stage is 34 or 35 feet, and as 18 feet is a very extraordinary rise upon the Illinois at this place, and 8 feet a large rise on the Fox, where not affected by the Illinois, it is evident that the difficulty from this cause cannot be very great.

One advantage of this water-power is that the mills are entirely away from danger of floating ice, and there is no local responsibility for maintaining the dam, which is under the control of the state. The banks of the river about the basin are rocky, and furnish excellent foundations for buildings.

Water-power at the "Canal cut".—There is one power at Ottawa owned by the La Salle County Manufacturing Company to which no allusion has yet been made. It is located on the main canal, where the race connects it with the hydraulic basin. The canal is above the general level there, and empties into the race by a lock with a lift of 5 or 6 feet. There are two manufactories located on the east side of the race, and using the head at the lock. One is a plow factory leasing one run, and the other a chair factory leasing two runs. The water from the wheels is delivered into the race. It is possible to further develop the power at this place, but far preferable sites can be obtained at the basin.

Unutilized power, from Ottawa to the Mississippi.—It has been already stated that there are no utilized powers on the canal below Ottawa. At Ottawa there would be available power were there any surplus water, but the La Salle Manufacturing Company is entitled to all there is. At La Salle, near the terminus of the canal, there is surplus water and a good site, with a head of 10 or 12 feet.

Upon the Illinois below Ottawa there is no available power. At Utica, 10 miles below Ottawa, there are rapids, but one bank is very low, and the place was described as being so ill adapted for development that it was not visited.

The total fall in the river from La Salle to its mouth, a distance of 230 miles, is only 33 feet, and this would preclude all idea of available power. It is true that there are two government dams already existing, with a lift of about 7 feet at each, and two more are proposed, but they do not offer any available water powers. In the first place, it is extremely doubtful if the United States government would allow the use of the power, the policy being to avoid all connection where possible with private interests, and past experience shows the soundness of this principle. In the second place, there are grave disadvantages and difficulties to be met in utilizing the power, even if permission were granted. Major Lydecker, of the United States engineers, stationed at Chicago, very kindly exhibited profiles showing that for much of the year there would be no head obtainable at the dams. The profile shows that for four or five months of the year the stage of the river is such that the level is practically the same above and below the Copperas Creek dam, and boats pass directly over its crest. It is thought that the difficulty would be even greater at the other dams.

When the state had finished the Henry dam, advertisements were made for bids for the lease of the water-power, but the report is that no bids were offered because of its unreliable character.

In low water, when there would be an available head, the government would probably not allow the water to be drawn below the crest of the dam, and this might occasion further difficulty. It is equally improbable that the government will allow the use of power from the proposed Hennepin canal and Dixon feeder if they are constructed, unless in special cases, in which prior rights exist.

TRIBUTARIES OF THE ILLINOIS.

KANKAKEE RIVER.

General description.—The Des Plaines, a tributary of the Illinois, has already been described, and as there are no streams entering it of any importance, the Kankakee comes next in order. After the Sangamon this is the largest in extent of area drained of all the branches of the Illinois. Thirty-two hundred of its 5,300 square miles are within Indiana, and of its length of about 140 miles, approximately 85 miles are located in that state.

The general course of the stream is southwest to the junction with its large tributary, the Iroquois, and then it turns northwest to where it joins with the Des Plaines to form the Illinois. The character of the river is very different in its upper and its lower portions.

The basin is generally level, but near the state line a ledge of limestone runs across the valley, and has so prevented the wearing down of the bed that a very large part of the drainage area in Indiana is one vast swamp, with wooded knolls and ridges rising here and there above it. In dry seasons the roads across this section are traveled, but when there is much rain they are well nigh impassible, and the river winds about with a scarcely distinguishable channel. Some of the higher land is cultivated, but the inhabitants are very scattered.

In Illinois the bed is not cut deep below the surface. The hills, or rather bluffs, are not high, but are well wooded, and the valley itself is a shifting scene of green meadow, thicket, and grove, down to the edge of the river.

It will be readily understood that the available water-power of the Kankakee is in the 55 miles (map measurement) from the state line to the mouth. The total descent between those two points is about 135 feet, and much of it occurs so as to be available. The bed is largely rock, and, with the banks, is suitable for the building of dams. The rim-banks are generally high enough to prevent extensive flooding of land. There are several dams already built, and a number of manufactories now using the power of the river.

Upon the upper waters there is slight fall, and no water-power of any account, except on the small tributaries.

The Yellow river, which joins the main stream near the source, is of about the same size, and, rising in the high land south of the swamps, has some available water-powers.

Flow, etc.—Notice has already been taken of the important bearing the swamps of the Kankakee have upon its character as regards steadiness of flow, making it in that respect the best water-power stream of the Illinois basin. The "ordinary low discharge" is about 1,300 cubic feet per second, but if it were not for the swamps the amount would probably fall to nearly half as much.

The local increase in the annual rainfall at the southern end of lake Michigan occurs within the Kankakee basin, but chiefly during spring and summer, while through the remaining seasons of the year the precipitation is rather less than on the other rivers of the Illinois basin. This greater inequality in the distribution of the rainfall throughout the year makes the swamps of special value in maintaining the flow. The lowest water is usually during September and October, the highest from late winter into April. Ordinary summer freshets take from 10 to 14 days to rise and disappear between ordinary stages of the river, and this below the mouth of the Iroquois, which, although it rises in the swamp region, drains a much greater proportion of dry prairie land, and is a comparatively "flashy" stream. This river is of about half the size of the Kankakee above the junction. Its freshets rise sooner, and pass off before those on the main river. The ordinary rise in the Kankakee is from 3 to 5 feet, but an extraordinary rise at Wilmington has reached 9 feet.

The swamps are thought to be gradually drying up, but not enough thus far to destroy their value in maintaining the flow. The proprietor of a large portion of the land once meditated cutting through the natural dam of rock and draining the swamp; this plan was abandoned, but has lately been agitated again.

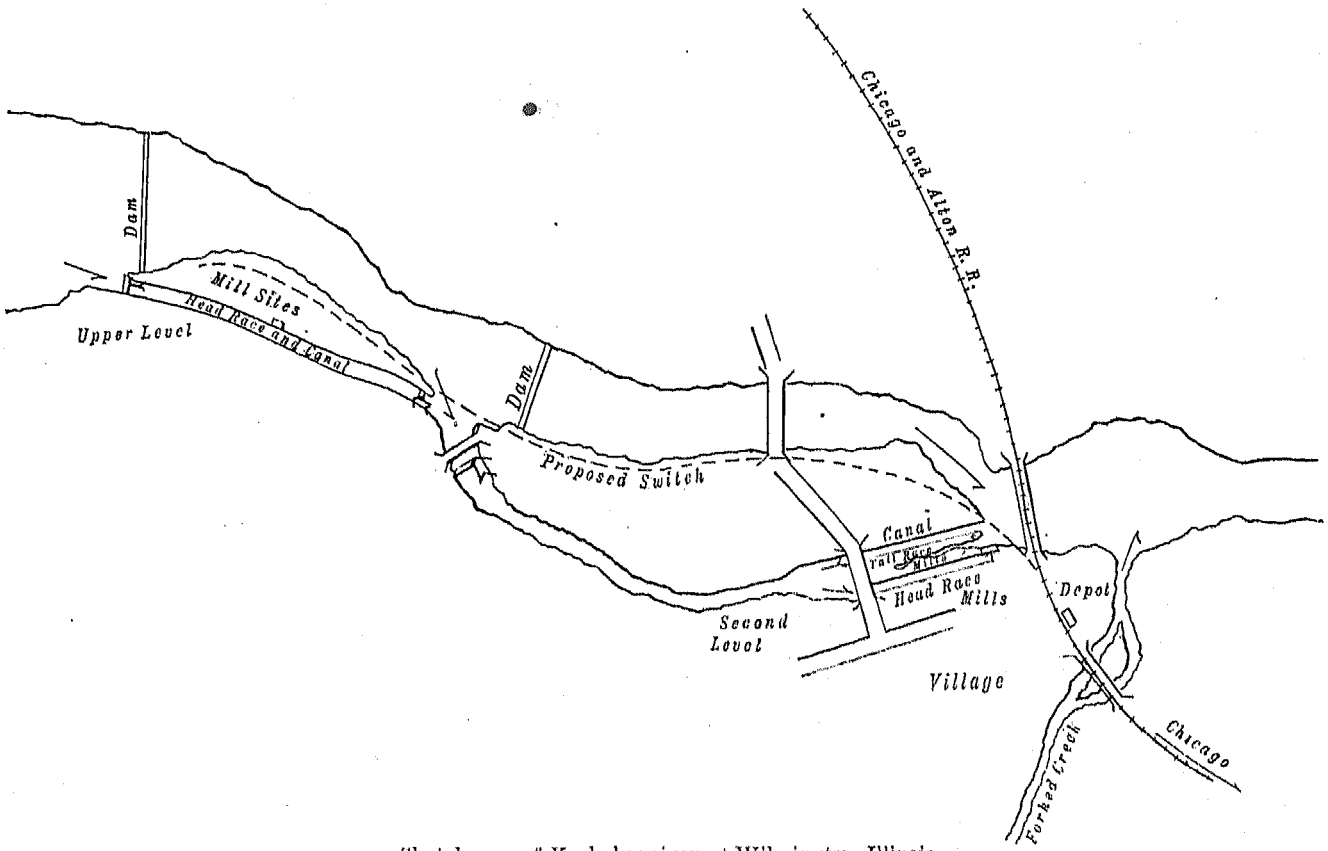
The Kankakee forms one of the few cases in which the cultivation and draining of the land is thought to better the water-powers; it brings into the river water which would otherwise have remained stagnant until evaporated.

While the swamp is a great regulator of the river, it cannot be always depended upon; sometimes it holds the waters fast, and the powers below have to suffer. If the fall rains are light and are followed by a severe winter, the swamps freeze so solid that little if any water escapes to feed the river, and the flow is sometimes insufficient even for the few mills now using the power. Fortunately difficulty from this cause is rare. A manufacturer familiar with the river for many years said that the only two years that he knew of, in which very serious difficulty occurred from this cause, were 1864–'65 and 1880–'81.

Navigation.—Being a large stream, extending through fertile country, attention has naturally turned to the improvement of the navigation of the Kankakee. A company of capitalists obtained a charter from the state of Illinois to improve the river for navigation and water-power. The Kankakee Company built three dams, and, in connection with the feeder of the Illinois and Michigan canal, has established slack-water navigation for about 20 miles from the mouth. Above that distance nothing has been done. The navigation is inconsiderable, but the improvement seems to have had an important effect in modifying the railroad rates for freight from the surrounding country. It is claimed by the state that the company has not made all the improvement required within the time specified, and that its rights are forfeited. The matter is yet in litigation, but the company is left in a rather unsatisfactory condition regarding its water-powers, which are more important to it than the navigation. There is

some hesitation in starting a manufactory upon a power whose ownership is uncertain. The endeavor has been made to have the United States government take the navigation in hand, the Kankakee Company offering to sell all but its water lots and power for $300,000, but the United States engineer reported unfavorably upon the scheme. It is claimed that with a very little dredging a natural navigable course, 7½ feet deep, can be obtained for nearly 100 miles through the swamp region. It is thought possible to run a canal across the summit to the Wabash river, and so form a route to lake Erie, but it would be difficult to feed the summit level, and there are other disadvantages in the way.

Water-power localities.—There are only four places on the entire river at which water-power is in actual use. These are Waldron, 35 miles from the mouth and just above the mouth of the Iroquois; Kankakee, 7 miles below Waldron; Wilmington, 21 miles below Kankakee and about 10 miles from the mouth of the river; and a power 1½ mile above Wilmington.



Sketch map of Kankakee river, at Wilmington, Illinois.

The two dams at Wilmington are owned by the Kankakee Company, which also has a dam 4 miles below Wilmington, although no power is utilized from it. Three-quarters of a mile below this dam is the state dam, for turning the water into the Kankakee feeder.

At Momence, 48 miles from the mouth of the river and about 7 miles from the state line, are the remnants of two dams and the ruins of a flouring-mill. This is the extent of the development of the powers of the river.

The Kankakee Company does not appear to lay any claim now to the powers above the three dams, and Mr. E. S. Waters, the engineer of the company, stated that he did not think any objection would be raised to the further development of the river above.

Powers of the Kankakee Company.—Though the finest improvements on the river belong to this company, the amount of power yet in use is comparatively small.

Everything is in readiness for manufacturers to build their bulkheads and turn the water upon their wheels; a large amount of power stands waiting, and apparently nothing but the legal difficulties of the company can deter manufacturers from availing themselves of it; nor does this seem a sufficient reason, for while courts may decide, and property change hands, water must run and the powers about Wilmington be of value.

The rate of leasing the power is $10 per year per horse-power, of which half goes to the treasury of the company and half is retained for the maintenance of the works. No arrangements have yet been made for a rebate during low water, as there is flow enough for all the mills now running. The locks, races, and connecting works, at the different levels are all constructed upon the right bank of the river, for convenience in making repairs. All the appointments are of a most thorough character, unusual to find in the development of western water-powers. The different levels controlled by the company will now be discussed in their order from the mouth of the river up.

State dam power.—The state dam, which turns the water into the Illinois and Michigan canal feeder, is about 5 miles above the mouth of the river. The company obtained permission from the state to raise the dam 2 feet, so as to make the navigation channel pass through the feeder, and thus get a head of 9 feet at the dam. A race could readily be built, and use made of the surplus of water that passes through the feeder. This latter amount is 500 cubic feet per second, and it is therefore probable that in very low stages there would be no surplus at all.

From the foot of the dam down to the mouth of the river there is a fall of about 20 feet, and this could be utilized by another dam, but the flow would be very unsteady, from the cause just mentioned. These powers are away from the railroads.

The feeder being under the control of the state, if any power were used from it negotiations would have to be made with the canal commissioners.

Near the lower end of the feeder there is a fall of about 30 feet, and mill-sites are available.

First level.—The first dam, 820 feet long, is three-fourths of a mile above the state dam, and backs the water up to the second dam, about 4 miles above. There are no races, but the work is planned so that they could be constructed upon the right bank. The available head is 8 feet, and 1,300 theoretical horse-power is available in ordinary low water. The site is several miles from a railroad station.

Second level.—The second level is located at the town of Wilmington, which is a place of 2,876 inhabitants, situated upon the right bank of the river, at the crossing of the Chicago and Alton railroad.

Some 600 feet above the railroad bridge is the foot of a forty-acre island, from 4,000 to 5,000 feet long and averaging 1,000 feet across, a natural park, richly covered with grass, and grouped with trees and the wild grape vine, in a way unrivaled by the landscape gardener. The main channel of the river, from 500 to 700 feet wide, is on the left of the island; the right or east channel is much smaller, and has been utilized as a canal and head-race for water-power.

At the head of the island the second dam, 650 feet long and 5 feet high, is thrown across the main channel. It backs the water into the right channel, which passes down to the town. Near the end of it a massive masonry dike is built across, with a lock for the passage of boats to the level below, and openings for the water to reach the mills. The roadway crosses the dike to the island, and then crosses the river.

The race ends about 1,000 feet below the dike. On the river side it is built with a retaining embankment terminating in a waste-weir about 150 feet long. A tail-race runs along the foot of this embankment. The buildings in which the power is used are between the head-race and the tail-race, except a flouring-mill at the extreme end. From the upper mill down they are as follows:

1. A flouring-mill, with five runs of stones, and leasing 60 horse-power.
2. A plane-shop and cutlery-shop, using 40 horse-power, with the intention of increasing it to 80 horse-power.
3. The flouring-mill at the end of the race, leasing 60 horse-power.

There is thus only 160 horse-power used of the 1,650 available during ordinary low water. The head at the mills is 10½ feet.

Forked creek, entering the river just below the mills, sometimes causes difficulty from back-water for a day or so.

The race could be continued down to the railroad bridge, and plenty of space obtained for the full utilization of the power. There is not much space between the head-race and the tail-race, and Mr. Waters considers the best plan to be to place the wheels between the two, and cable the power across the head-race. On the large island there are places above the road where the channel could be tapped and mills supplied with a head varying between 10 and 5 feet.

Near the abutment of the dam are ten fine gates set in masonry, by which the height of water in the race can be controlled to an inch. There is also a lock for the passage of boats.

Third level.—The power of the third level is by far the finest controlled by the company, and is all in order for immediate use.

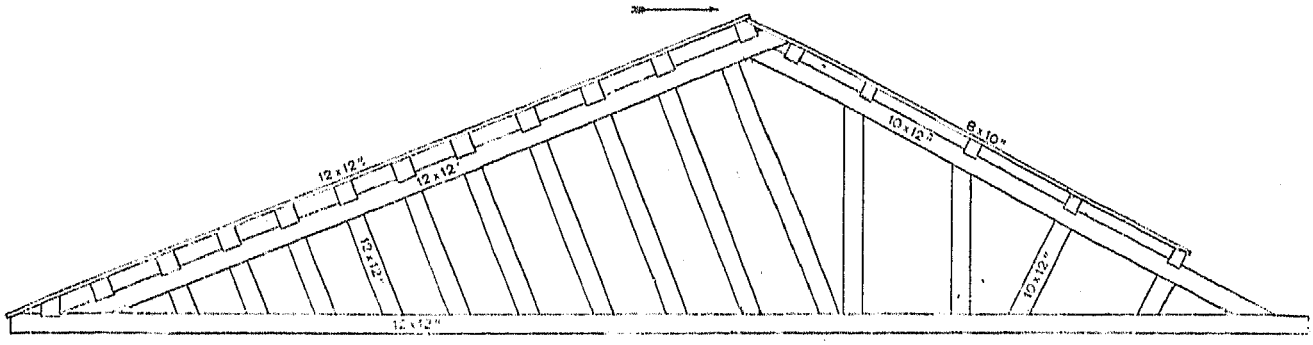
The dam is about 1⅛ mile above Wilmington, and is a very fine structure, 1,000 feet long and 16 feet high, backing the water 12 miles up-stream. The power is taken from a race running down the right bank, 3,000 feet long, 100 feet wide, and 8 feet deep. The average head is 15 feet, and the power is estimated to be 3,000 theoretical horse-power with ordinary low water. The long stretch of deep, still water prevents the formation of any anchor ice. At the head of the race are eight gates, with 7 or 8 feet depth of water on the sills, and after passing through the gates the water flows through four culverts into the race. There is a guard-lock 20 feet wide, closed only in high water. Navigation is through the race, and at its foot is a lock with a lift of 15 feet to the second level. This lift is not exceeded in the state. Beside the lock is an overflow 30 feet wide.

The land through which the race runs slopes slightly to the river, and the race is built up with an embankment on that side. Manufactories would be located just back of this, and receiving their water through it, would discharge into tail-races leading across the flat. The ground is a stratum of limestone thinly covered with soil, and makes excellent foundations. The tail-races have to be partly excavated in the rock. The land slopes gently back on the right-hand side of the race, affording excellent sites for workmen's cottages, should manufacturing requiring many hands be carried on.

There is now only one industry on this level, a straw-paper mill, situated near the center of the length of the race. It uses 80 horse-power, and has a capacity of 10 tons of paper per day. There was in the spring of 1881 some prospect of a cotton factory being built. The Chicago and Alton railroad has agreed to run a side track up the island to the mills when another one is erected.

Dams of the Kankakee Company.—The three dams of the company were constructed by Mr. Waters on the same plan, and hence a description of the upper one will serve for all.

The bed of the river at Wilmington is a gray limestone, full of fossils and cavities, belonging to the Niagara formation. It is the stratum overlying the celebrated Joliet stone, and in descending it is found to become more yellow and white. Although this stone wears and shells out to some extent where the water strikes, it nevertheless makes an excellent foundation for dams.



Section of upper dam of Kankakee Company, Kankakee river, Illinois.

The dam is a timber frame-work 66 feet wide at the base and sharp at the crest. The slope at the back is 2½ to 1, and of the apron 2 to 1. Norway pine is used for the timbers, and oak for the planking. The timbers of the dam proper are 12 by 12 inches, and the planking is 3 inches thick. The frame of the apron is of 10 by 12 inch timbers, with 8 by 10 inch scantlings, and 2-inch planking. The scantlings are notched into the rafters and fastened by ¾-inch drift-bolts. The struts supporting the rafters are placed nearer together toward the toe, where the depth of water is greater. The sets are bolted to the rock by 1½-inch iron drift-bolts, six to each set. The toe of the planking runs down into the gravel to the rock, and in some places cement was used to prevent leaks. The back of the dam is heavily covered with gravel and stone. The mud carried down by the Iroquois river closed the dam so tightly that no air was admitted to the timbers, and dry-rot was setting in. To remedy this the planking was cut away at the foot of the apron. The construction admits of the easy renewal of timbers without tearing the dam open, and a yearly inspection is always made.

The first dam is 820 feet long, 8 feet high, the sets 8 feet apart; the second, 650 feet long, 5 feet high, the sets 10 feet apart; the third, 1,000 feet long, 16 feet high, the sets 6 feet apart.

The river from Wilmington to Kankakee.—There is no available fall between the upper level at Wilmington and Warner, about 12 miles above, but in the succeeding 2 or 3 miles to Altorff there is about 9 feet of natural fall. It is practicable to erect a dam at Warner and obtain a head of about 8 feet.

At Altorff there is an island, and an old dam across the right channel. The dam over the left channel was carried out. There is an old mill at the right bank of the river which does custom work, gaining power by throwing a wing-dam up the left channel in low water. It is of small importance now, although twenty years ago it was a good flouring-mill, with a head of 10 feet. A dam could be built over both channels.

It was the original intention of the Kankakee Company to build a dam at Altorff and run a canal down to Warner through a natural ravine, using it for navigation and water-power, thus obtaining a large head of water.

From Altorff to Kankakee there is a rise of 12.7 feet, according to survey, and power is available, although none is used.

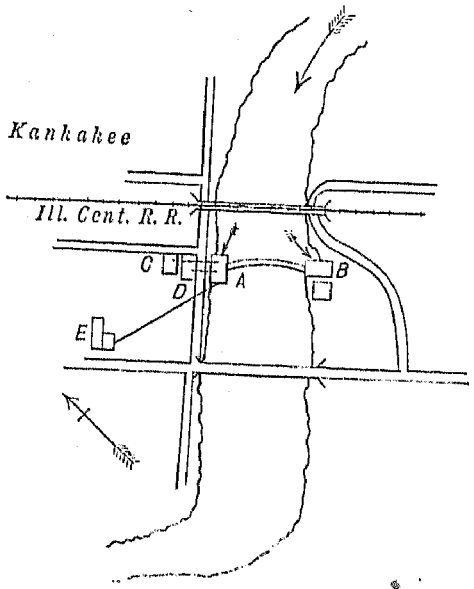
Kankakee.—At Kankakee a dam extends across the river, and five establishments use the power, which is owned by Mr. James McGrew, the proprietor of the flouring-mill. The rim-banks are 10 or 15 feet high, and from them the land slopes gently back. The bed, and the banks for about half their height, are of limestone. There are no races, but excellent facilities for excavating them on each side. The head is 9 feet during low water, and averages 7 or 7½ feet.

At the left abutment of the dam is a paste-board mill, leasing 60 horse-power. At the other extremity of the dam is the flouring-mill, with nine runs of stones, and using 150 horse-power. In the flouring-mill are three other wheels, one transmitting 30 horse-power, by shafting, to a woolen-mill across the street, another transmitting 40 horse-power, by shafting, to a flaxseed-oil mill behind the woolen-mill, and the third furnishing, by means of wire rope, 10 horse-power to a foundery and machine-shop.

All the powers rented now are on an equality, and the proprietor does not feel at liberty to rent any more first-class powers, as in very low stages of the river the full power is used. However, during most seasons, there

would be no difficulty of this kind, and he thinks that 50 per cent. more power could be rented as second-class with advantage. An arrangement is made with the lessees whereby the pond is never drawn down more than 6 inches below the crest of the dam.

No rebate is paid for a stoppage from lack of water of less than forty days per year. This seldom, if ever, occurs. Even with the paper-mill, which has smaller wheels than are used on the other side of the river, the average stoppage is but from twenty to twenty-five days per year, and this is mostly due to back-water.



Sketch map of Kankakee river, at Kankakee, Illinois.

Some distance below the mills the river narrows and causes back-water, so that a 1-foot rise above the dam is equivalent to about 3 feet rise below it, within certain limits. The head sometimes diminishes to 4 feet. Sometimes also there is slight difficulty from anchor ice.

The dam is a timber frame-work, curved up-stream, 500 feet long, with sets in the form of a right-angled triangle. The base is 20 feet wide, and the height 10 feet. The sets are 4 feet apart, and are not fastened to the rock in any way; 10 by 12 and 10 by 10 inch timbers are used, and 2-inch planking. There is no gravel or stone filling above the dam, but the toe is carefully fitted to the rock. Occasionally there have been slight leaks filled up with gravel. The dam was formerly 2 feet lower, but was raised to its present height by two courses of 10 by 10 inch scantlings laid over the sets, and then two layers of 2-inch planking. The foundation is good limestone, which has been worn out to a certain extent by the vertical pitch of the water and ice over the dam, but this action has now ceased.

The river above Kankakee.—The Kankakee pond backs up to the Waldron power, 7 miles above, and extends 1½ mile up the channel of the Iroquois river.

Waldron.—Waldron is a small village just above the mouth of the Iroquois. No visit was made to the place, but information was obtained that there are, on a race, a paper-mill, a custom flouring-mill, with four runs, and an elevator and corn-sheller. The head is 8 or 9 feet. This power is above the Iroquois river, and hence steadier than the powers below the junction. The dam is 400 or 500 feet long. The pond backs up about 5 miles.

From the crest of the Waldron dam to the surface of the river at the state line the rise is 20 feet.

At Momence, which is 10 miles above Waldron, there are the ruins of two old dams and a flouring-mill. The upper dam backed the water to some extent into the swamp region.

A head of about 8 feet is available at Momence, and there is a fall of nearly 13 feet from the river at the lower dam to the Waldron pond. At this place the water-power section ends; we pass into the swamp section, in Indiana, where there is little fall, and no power available.

Tributaries of the Kankakee.—The utilized water-power of the side streams is very small in amount. There are a few mills upon the upper tributaries which flow out of the high land surrounding the swamp, but not more than three or four. On the small brooks entering the river in Illinois there are no mills, and the Iroquois is the only tributary of size.

The Iroquois river.—The Iroquois has not so much fall as the Kankakee, and, as already mentioned, is so unsteady as to materially influence the main river below the junction. The source is in the swamp region of Indiana, scarcely separated from the upper waters of the Kankakee, but most of the basin is level or rolling prairie. In the region about Gilman, in the western part of the basin, are many artesian wells, which add materially to the flow of the river in ordinary low water. The river is considered to be about one-half the size of the Kankakee above the junction.

There are only three mills on the river, one at Sugar Island, about 5 miles from the mouth; one at Texas, about 5 miles below the state line; and one at Rensselaer, in Indiana, near the source. These are grist-mills with two or three runs of stones, under heads of 6 to 7 feet. It is considered that the river will not run a much larger mill to advantage.

THE FOX RIVER.

The Fox river rises in Wisconsin, northwest from Milwaukee, flows south, and then southwest in Illinois, and enters the Illinois river at Ottawa, 35 miles below the mouth of the Kankakee. Its basin is about 130 miles long and averages 20 miles wide; 1,080 square miles are in Wisconsin, and the remainder of its drainage area lies in Illinois, making the total 2,697 square miles. About the upper waters are several lakes, of which Geneva lake and Fox lake are the chief. These serve to a certain extent to regulate the flow, but are not numerous or large enough to make the river a very steady stream. There is no marked difference between the upper and the lower portions of the basin, as in the case of the Kankakee. The country is undulating prairie, with more or less woodland and some swamp.

The low-water discharge of the river is estimated to be 526 cubic feet per second, or 0.195 cubic foot per second per square mile. Those familiar with the stream claim that it has fallen off *one-half* in its low-water volume since the clearing and cultivating of the land and the draining of the swamps. From 15 to 18 feet is an unusual rise in the river near its mouth.

The valley is a quarter of a mile to a mile wide, with sloping bluffs, and the varying woods and grass-land make a pleasing picture. Toward the sources the valley is less deep than below, and the bed is in the drift which covers southern Wisconsin so thickly.

There is considerable fall in the river, but less in Wisconsin than below, where it averages nearly 3 feet per mile. The total fall in the last 47 miles, from Aurora, is 136 feet. In the last 5 miles the descent is about 6 feet per mile. The fall gives rise to a number of water-powers, and of these there are sixteen utilized to give power for fifty-six establishments, using 2,712 horse-power. There is a great variety of industries—flouring- and paper-mills, founderies, tool-factories, wire-works, hardware, carriages, sash and blinds, etc.

In visiting the river the journey was taken up-stream, and the powers will now be considered in that order.

From the mouth to Dayton.—In the distance of about 5 miles from Ottawa to the Dayton mills, the river falls at least 10 feet. So far as the nature of the bed and banks is concerned, this is available for power, but it is not advisable to improve it, because all but a quarter of the low-water flow of the river passes into the canal feeder at Dayton, and the remainder is too inconsiderable to make improvement profitable. The La Salle County Manufacturing Company of Ottawa to a large extent bought up the rights on the river below Dayton, so as to prevent lawsuits.

The Dayton power.—The canal feeder starts from the right bank of the river about a third of a mile above the village. On the right the land rises in a steep bluff for about 50 feet. The left rim-bank of the river is much lower. From the dam down to the village are rapids over a hard variety of Saint Peter sandstone, which also forms the banks to some extent. The space between the feeder and the river gradually widens into a level about 200 feet across at the village. The manufactories are built on this, taking the water from the feeder. A road runs past the mills and up the bluff to the main road and the railroad depot, only a short distance away.

Reference has already been made to the ownership of the power and the removal of three-quarters of the flow to Ottawa by means of the feeder. The remainder is used at Dayton, but in low water the state has the first right of the river, even over this Dayton power. The Dayton mills have the first right after the canal is supplied. The head of water available at the mills is 20 feet, and the total power is estimated to be 228 theoretical horse-power in low water.

There is no serious difficulty from back-water, as the river flows rapidly below the mills. The ordinary rise is 10 feet, though sometimes 15 feet is reached.

The manufactories in their order from the dam are these:

The Dayton Woolen Mills, entitled to three-eighths of the power, of which about 15 horse-power is used by a horse-collar factory next below. Below the collar-factory are a flouring-mill and a tile-factory, in the same building, entitled to three-eighths of the power. Last is the paper-mill, entitled to the lease of one-fourth of the power, but not using it all. All use a head of 18 feet.

There is no surplus power to be disposed of, although the privilege is not in full use.

The dam is 400 or 500 feet long, and is built entirely of 2-inch pine planks, 10 inches wide, laid in a crib-work and spiked together. Then the spaces were filled with drift bowlders, called "hardheads". The stringers were laid 4 feet and the headers 10 feet apart. Iron drift-bolts were let into the rock bed. The dam is faced with 2-inch oak planking. The total cost was $15,000. There is a guard-lock at the entrance to the feeder, and when seen the water was running from 6 to 12 inches deep over the dam, and the lift in the lock was about 4 feet.

From Dayton to Millington.—The Dayton pond sets up-stream about one-half mile. In the 20 miles up to Millington there is no power developed, but some is available. One and a half mile above Dayton is a site where a head of 8 feet can be obtained with a dam about 300 feet long. The bed is hard Saint Peter sandstone, and the banks are good. A race could easily be constructed on either side.

The next available place is at Wedron, 3½ miles above Dayton. There was once a saw-mill with a head of about 6 feet at Wedron, but there is no mill now. There is a good opportunity for a race on the west bank.

From Wedron up to Millington there is not much fall, and there are no specially good sites.

Millington.—At Millington is a dam, partly broken out. The foundation is gravelly in nature. There is a race on each side, and 5 feet head of water. On the east side is a grist-mill with two runs of stones, and on the west side a woolen-mill, unused for the last 10 years.

Yorkville.—The Millington pond backs up 2 miles, and there is no power in the remaining 8 miles to Yorkville. At Yorkville there are a saw-mill, a flouring-mill, and a paper-mill, using the power on the east bank. The head is 5½ feet, and 150 or 200 horse-power is used. There is a surplus, except in very low water.

From Yorkville to Oswego.—The distance from Yorkville to Oswego is 7 miles, and includes a small unimproved power with a head of about 3 feet, 2 miles below Oswego. At Oswego there is a flouring-mill on the right bank, and a saw-mill and furniture factory on the left bank, both at the abutments of the dam.

The average head is 6 feet. The flouring-mill has five runs, and wheels capable of furnishing 90 horse-power. The saw-mill and furniture factory have 60 horse-power. There is much unutilized power and the facilities are excellent for building races on both banks.

There is no difficulty from back-water or from low water, and the only stoppage is for one or two days, owing to anchor-ice. The dam is 390 feet long and 6 feet high. The bed and banks are of limestone.

Montgomery.—The next power available is at Montgomery, about 3 miles above Oswego. At this place there is a dam, and a race upon the right bank. There are here a malt-mill, formerly a sash-factory, with two 48-inch wheels, under a head of 5 feet; a feed-mill, with two runs, and a flouring-mill, with five runs, both under 5½ feet head of water.

Aurora.—The next available power is at Aurora, about 2 miles above. Aurora is a city with 11,825 inhabitants, 47 miles (map measurement) from the mouth of the river.

An island divides the river into two channels, and a dam is thrown across each of these near the head. A race runs down the right bank of the river, and one down the island. The street crosses the river by two bridges at the lower half of the island. On the left bank of the river, immediately at the dam, are the City Flouring Mills, with five runs and a wheel-capacity of 127 horse-power, under a head of 6 or 7 feet. On the island race are a silver-plating establishment, using 30 horse-power, under a head of 6 feet, and Mr. Stolph's woolen-mill, using 50 horse-power, under the same head. On the shore race are the foundery and brass-works of Hoyt Brothers, using about 60 horse-power, under a head of 7 feet. There is very little difficulty experienced with the power in winter, but in summer the water is sometimes below the amount required. The flow in ordinary low water is considered to be 500 cubic feet per second.

The left bank of the river is all built up to the water's edge, and there is no place for a race. There are vacant sites upon both of the existing races. There are the ruins of a mill below the foundery on the shore race. The dams are of timber, amounting to about 500 feet in length. The bed is of limestone.

There is litigation concerning the division of the power. The shore race belongs to the Alexandra estate, and the island race to Mr. Stolph. The Hoyt Brothers own 400 "inches" of water, and the city owns 100 "inches". The remainder is divided between the Alexandra estate, Mr. Stolph, and the City Mills, and about this is the dispute.

North Aurora.—North Aurora is 3½ miles above Aurora, and half way between them is an unimproved power, where there was once a dam, with a head of 5 feet.

At North Aurora there is a flouring-mill, with four 48-inch wheels, under a head of 5 feet, a sash-factory and foundery together, with three 60-inch wheels, and an old, unused saw-mill. The dam is of timber, with a clay and gravel foundation. It is the intention to raise the head to 6½ or 7 feet.

From North Aurora to Batavia.—There is no developed power up to Batavia, about 3½ miles above, but half way between is what is known as the "Stevens power", a good site, with a head of 8 feet available.

At Batavia there is an island, with the main channel on the east. A dam was thrown across this, and the slough on the right closed by a dike.

At the dike is the Batavia Paper-Mill, on the upper part of the island is the Newton Wagon Company, and on the east shore the Challenge flouring-mill. The paper-mill uses 200 horse-power, with a head of 8 feet; the wagon-factory 40 horse-power, under about the same head; and the flouring-mill about 50 horse-power, under a head of 6 or 7 feet. The flouring-mill owns 400 "inches" of water, and of the power belonging to the paper-mill 600 "inches" of water have the first right over all the other powers. Usually, in the fall, there are one or two months when the paper-mill has to run at less than full capacity.

Geneva.—The Geneva power, 2 miles above, is the next on the river. There are four establishments, a grape-sugar mill and a foundery on the right bank, and a grist-mill and a flouring-mill on the left bank. The head is 6 feet.

The foundery owns 300 "inches" of water, the sugar-mill 1,200 "inches", the grist-mill 300 "inches", and the flouring-mill 1,232 "inches". In addition to this there is what is called a "surplus" of about 3,000 "inches", of which the flouring-mill owns one-half, the grist-mill and sugar-mill own 200 "inches", and the remainder is owned by the foundery. Sometimes the mills are troubled with low water.

Saint Charles.—Next is the power at Saint Charles, 2½ miles above. It has two flouring-mills, one of three runs and the other with four runs, a paper-mill using 65 horse-power, and a foundery. The head is from 4 to 6 feet.

Clintonville.—The next available power is at Clintonville, 6 miles above. Formerly there was a dam there with a fall of 6 feet, but it was carried out in the spring of 1881, and the mills have burnt down.

Elgin.—Elgin is 9 miles above Saint Charles, and is somewhat noted as a manufacturing town. There is a race on each side of the river, and thirteen establishments use the power. The dam was carried out in the spring of 1881, but it was thought probable that it would be rebuilt, although there was a tendency to wait until the ice-dealers would agree to bear part of the expense. The average head of water is 7 feet. The power is owned by a hydraulic company, and the distribution was stated by the president to be as follows:

West race.	"Inches."
Flouring-mill and a machine-shop	1,900
Flouring-mill	1,200
Foundery	200
Planing-mill	400
Tannery	200

East race.	"Inches."
Flouring-mill	1,166
Flouring-mill and a machine-shop	1,150
Machine-shop	900
Woolen-mill	1,100
Machine-shop	200
Wire-works	400
Agricultural implements	200

All the powers are on an equality, and when the water has been low the manufacturers have divided the time of running in proportion to the amounts owned.

The bed of the river is gravel for a depth of 30 feet, but this is now largely replaced by stone and timber at the site of the dam.

Carpentersville.—There is no power between Elgin and Carpentersville. At this place is a flouring-mill on the east bank, and on the right bank are a foundery and a bolt factory. The dam was carried out in the spring of 1881.

Algonquin.—At Algonquin is the next available power, 6 miles above Carpentersville. There is a dam across the river, and a small flouring-mill on the left bank.

From Algonquin to the source.—The river is less rapid in the upper part of its course, and hence has fewer available powers than below. It averages 150 or 200 feet wide, and flows between gravel and clay banks. In some places it runs close to the bluff, and in others a low flat intervenes. Fox lake is a marshy expansion of the river.

The utilized powers above Algonquin, so far as can be ascertained, are these:

At McHenry are two small flouring-mills.

At Wilmot, in Wisconsin, is a three-run mill with a head of 3 or 4 feet, using 60 horse-power.

Above Wilmot are three flouring- and grist-mills, using 40, 60, and 60 horse-power under heads of 4, 6, and 13 feet, respectively.

Tributaries of the Fox river.—The tributaries of the Fox are necessarily small from the shape of the basin, and have no very important water-power. There are some small mills upon White river, the Nipper-sink, Somanauk creek, Salt creek, and other streams.

White river is the outlet of the clear and beautiful lake Geneva, in Wisconsin, 8 miles long and from one-half to 1 mile wide. It furnishes a remarkably steady power, utilized in three places. At the outlet of the lake are a flouring-mill and oatmeal-mill, with a total of eight runs of stones under a head of 13 feet. All the power is used. Three-quarters of a mile below are a woolen-mill and manufactory of agricultural implements, with a head of 8 feet, and below is a flouring-mill with a head of 10 feet and three runs of stones.

VERMILLION RIVER.

This stream drains 1,413 square miles of undulating prairie and moderately wooded country. It is not of much value for water-power. The only utilization of power is by a flouring-mill, using 45 horse-power, at Pontiac, a small grist-mill below, and zinc-sheet factory, using 10 horse-power, at the mouth. Formerly there were mills at distances of 3, 10, 18, and 23 miles below Pontiac, but now they are all gone.

The banks and the bed of the stream are generally fairly good, and in many places they are of rock. The chief difficulty is the unsteadiness of the flow. The slope is moderate. The mill at Pontiac had a head of 8 feet, and flooded up-stream 2 or 3 miles. The head at the old mills averaged between 7 and 10 feet.

It is said that there is less flow in low water near the mouth of the river than at Pontiac, because of filtration through the bed; also that there are some springs entering just above Pontiac, and that hence the river is more unsteady near the mouth. The draining and cultivating of the land during the last twenty years is thought to have increased the total flow for the year, but to have also added to its irregularity.

The dam at Pontiac was carried out by ice in the spring of 1881. The bed is there a thin cap of shaly limestone, underlaid by soapstone. The soapstone wears out where exposed to the current. There is much difficulty from back-water, and sometimes the wheel cannot run for two or three weeks. Steam is used to some extent. The river at Pontiac is from 60 to 75 feet wide in a good stage, and 1½ foot or 2 feet deep, with a moderate current.

MACKINAW RIVER.

This is a very inferior stream for water-power. Its drainage-basin is 1,182 square miles in extent. According to the census returns there are five flouring- and grist-mills upon the river, using a total of 175 horse-power under heads varying from 5 to 9 feet. The largest power used is 60 horse-power.

The river was better for water-power before the country was cultivated; now there are heavy freshets, and very low stages in late summer. The banks and bed are generally inferior for dams, of a sandy nature, or else of the black loam, which washes easily. With a good stage the river would give power along its lower part for about three runs of stones under a head of 10 feet.

SPOON RIVER.

The Spoon river drains 1,905 square miles in the western portion of the Illinois basin. There are six flouring- and grist-mills on the river, several of them with a small saw-mill attachment. These are all in the last 40 miles above the mouth. They use a total of 249 horse-power under heads varying from 7 to 11 feet, the largest taking 64 horse-power. The names are: London mill, Ellisville mill, Babylon mill, Seville mill, Bernadotte mill, and Duncan's mill, the last about 8 miles from the Illinois. Duncan's mill has about 6 runs, and is the finest mill on the river. Boats can ascend to this mill, which is at the edge of the flats bordering the Illinois.

There was once a scheme started for slack-water navigation to London Mills, but after the sinking of several thousand dollars it was abandoned.

From London Mills down to Bernadotte, 15 or 20 miles from the mouth of the river, the channel is through a light gray sandstone, which is used quite extensively for building. From Bernadotte to Duncan's mill the bed is in a shaly limestone, and below that, in the alluvium of the Illinois flats. Between London and Duncan's mill the banks are generally good for dams.

The river has the usual spring freshets and is very low in summer. Sometimes east of Bushnell, in the lower part of its course, it is not more than 35 feet wide, with a moderate current from 8 to 12 inches deep.

SANGAMON RIVER.

The region of 5,592 square miles drained by this stream was known fifty years ago as the Sangamie region, and the river was called the Sangamie river. The latter divided about 35 miles from the mouth into the North fork, now called Salt river, and the Middle fork, which is now called the Sangamon river. The stream entering about 35 miles above the mouth of Salt river still goes by the name of the South fork.

East of the third principal meridian, which cuts off the eastern third of the basin, is the "bluff country", which is somewhat undulating and elevated; west of it the land is level prairie. Approximately along this line is the "cut-off", so called because the timber here ceases. West of it there is little timber except along the streams, while east there are large bodies of white oak, especially in Macon county. The land is an exceedingly fertile, rich, black loam, especially adapted to corn. Stock-raising is very largely carried on.

There is very little water-power used in the basin. The census returns show a total of 235 horse-power used by fourteen grist- and saw-mills. The heads used vary from 3½ to 12 feet. The largest power used is 30 horse-power under a head of 12 feet. There are three grist-mills and one saw-mill on the main river, using 73 horse-power. On the South fork is one grist-mill using 30 horse-power. The returns credit Salt river with six grist-mills and three saw-mills, using 132 horse-power.

The river is of very little value for water-power, owing to the variation in its flow and the insecure bed and banks. Little if any rock is found along the banks, and in some places the river flows through quicksand. It is about 75 feet wide at Decatur and from 100 to 200 feet wide in the vicinity of Springfield. The rim-banks generally are from 6 to 12 feet high. High water floods the land in some places for 2 or 3 miles in width, but in late summer and fall the flow is very small.

The river was formerly more steady than now, and floods took three or four weeks in rising and disappearing. There were large collections of drift-wood, etc., in the bends, which retarded the flow, and the water running up the courses of the side-streams among the roots and grasses of the swamps was much delayed in its passage to the Illinois. Now the drift-wood is burnt out, and the land drained and largely cleared off. The river-bed is scoured out deeper, owing to the freer passage of the water.

CROOKED CREEK AND MACOUPIN CREEK.

The first drains 1,286 square miles and the second almost exactly 1,000 square miles.

Crooked creek has only two grist-mills, using 28 and 20 horse-power, under heads of 8 and 7 feet, respectively. At one time there were more mills on it, but it is unimportant for power.

Macoupin creek is small, sluggish, and has no utilized power.

EASTERN TRIBUTARIES OF THE MISSISSIPPI, FROM THE ILLINOIS TO THE OHIO.

The only streams of any size in this distance of 213 miles are the Cahokia creek, entering the Mississippi opposite Saint Louis; the Kaskaskia, called the Okaw by the Indians; and the Big Muddy. There is only 107 horse-power in use from the streams in the entire district.

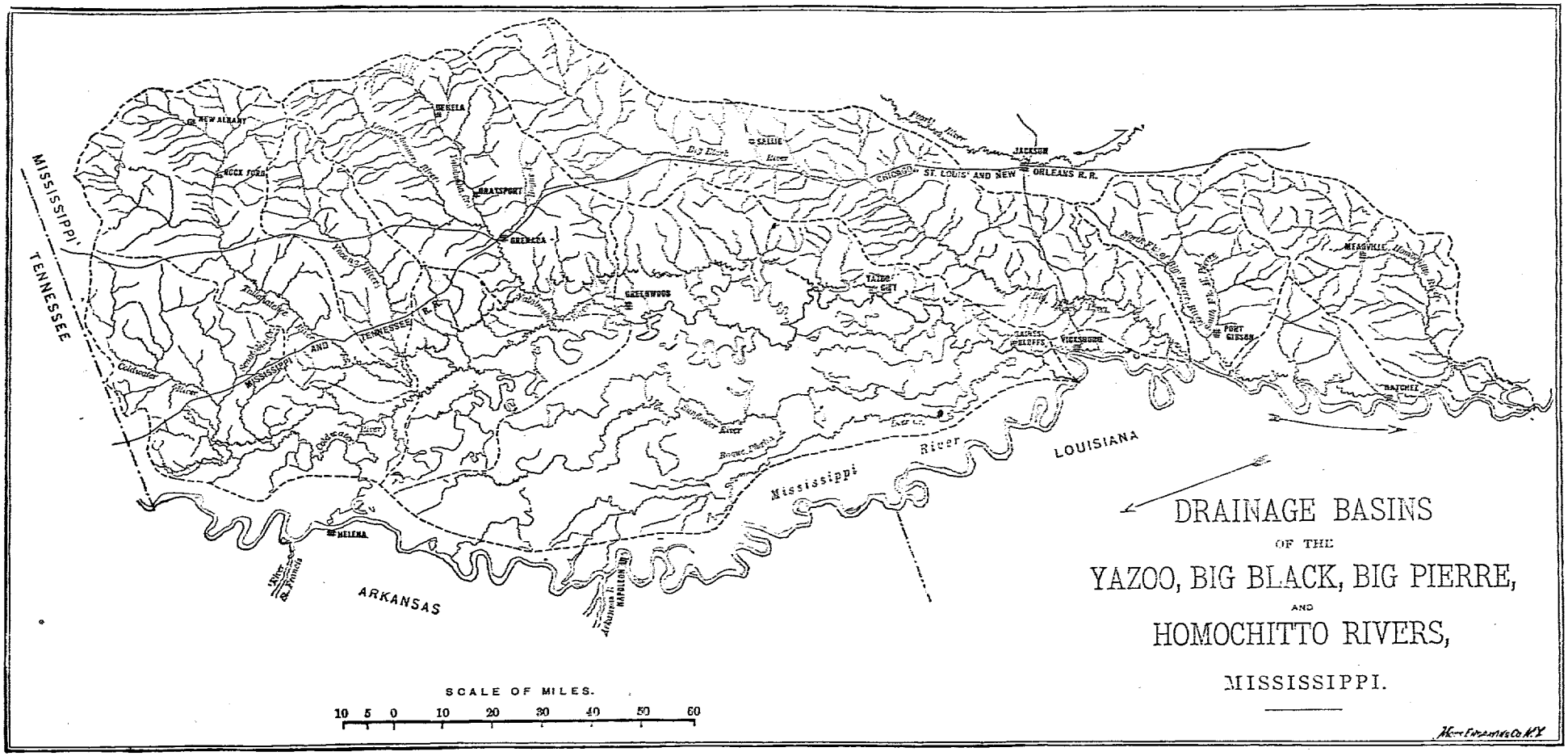
Cahokia creek is a small stream, draining only from 300 to 400 square miles, with no mills upon it, and is of no importance for water-power.

The country drained by the Kaskaskia and the Big Muddy is level or undulating, and the soil is largely "mulatto soil", a yellowish-brown clay. This is well adapted to winter wheat, which is the staple crop, while corn is not so abundantly raised as on the black loam farther north. There is considerable timber, especially in the Big Muddy basin; white oak, poplar, hickory, elm, and sycamore, among others. The black walnut has mostly been cut off. Oak, hickory, and poplar are quite extensively manufactured into lumber.

KASKASKIA RIVER.

The drainage basin of the Kaskaskia measures 5,876 square miles and is 180 miles long, the narrow upper end reaching within 40 miles of the state of Indiana.

There are only two grist-mills on the stream, one using 30 horse-power, under 6 feet head, and the other 12 horse-power, under a head of 4 feet. These are located near the central part of its course.



DRAINAGE BASINS
OF THE
YAZOO, BIG BLACK, BIG PIERRE,
AND
HOMOCHITTO RIVERS,
MISSISSIPPI.

Mac Farlane & Co. N.Y.

The river has little descent, and in summer and fall dwindles to a small size. At times it can be crossed dry-shod at Vandalia, about midway between the source and the mouth, where it is 60 or 70 feet wide. Along most of its length the bed and the banks are of clay and gravel, not of very good quality for the location of dams. These causes conspire to make it an undesirable stream for the development of water-power. Notwithstanding, thirty or forty years ago, when there was little capital and few means existed for getting machinery for steam-mills, the river was used from necessity, and had several grist- and saw-mills upon it. A very few of the dams are yet standing.

The most rapid part of the river is for 15 or 20 miles above Shelbyville, on the upper third of the course, and in this distance most of the mills (five or six) were located. In this 15 or 20 miles the bed and the banks are largely of limestone or sandstone. Usually there is a rocky bluff on one side and a lower bank upon the other. Above and below this section the bed and the banks are of soft material.

The only tributary of the Kaskaskia which can boast of any utilized power is Shoal creek, the largest branch stream of the basin. It has two grist-mills upon it, using 30 and 35 horse-power, under heads of 8 and 10 feet, respectively.

BIG MUDDY RIVER.

The basin has an elliptical shape, with a major axis about 70 miles long and a minor axis about 50 miles long. Its extent is 2,374 square miles.

Beaucoup creek enters from the north, 25 or 30 miles from the mouth, and the Little Muddy river enters from the same side, about 10 miles farther up. These two streams together drain about the same area as the main river above the junction, and Beaucoup creek drains about one-half more area than the Little Muddy. There is not an industry using water-power in the entire basin. Years ago there was a three-run mill at Blairsville, on the main stream above the junction of the Little Muddy, with 5 or 6 feet head of water, but the dam was frequently carried out and was finally abandoned.

The river has only slight fall and is very unsteady. At Murphysborough, about 6 miles below the junction of Beaucoup creek, where it is about 160 feet wide, with rim-banks 10 feet wide, the water has risen 30 feet, flooding the surrounding flats. Back-water is experienced there from the Mississippi. The discharge becomes very small in dry weather, and it is largely its fluctuations which makes the Big Muddy so unsuitable for water-power. The bed and banks are chiefly of clay, not very secure for dams.

The tributaries share the characteristics of the main stream. Beaucoup creek is the principal one. There is an extensive bend on the Little Muddy where a claim was once entered for a mill-site, but no use was ever made of it.

EASTERN TRIBUTARIES OF THE MISSISSIPPI, BETWEEN THE OHIO AND THE YAZOO.

General remarks.—The large drainage basin of the Ohio, 214,000 square miles in extent, with its immense tributaries and many water-powers, is the subject of a separate report by Mr. Dwight Porter, and now the section engaging attention is a strip 600 miles long, including the western limit of Kentucky and Tennessee and half of Mississippi.

Although so long, the area included is comparatively small, for the water-shed line of the Yazoo basin, such as it is, runs close to the Mississippi through the entire length of the state of Mississippi, and it is only in Tennessee that the region extends to a width of 70 or 80 miles. There, within a distance in a north-and-south direction of about 125 miles, are all the streams of any importance between the Ohio and the Yazoo basin. They are, in order, the Obion, the Forked Deer, the Big Hatchie, the Loosahatchee, and the Wolf.

The Obion and the Forked Deer unite near the Mississippi, and their combined drainage area is 4,306 square miles, nearly equally divided between them. The Big Hatchie rises in Mississippi, and drains 2,726 square miles. The Loosahatchee and the Wolf, uniting, like the two streams just mentioned, drain 1,392 square miles.

The "plateau slope of west Tennessee" has much fertile land, and is especially noted for its timber, which grows to a great size. In 1870 over a third of the wealth of the state was included in this region. Lumbering is a very important industry, especially along the Obion river, and there are many steam saw-mills at work. Oak, cypress, hickory, poplar, etc., are cut.

Along the sources of the rivers the land is elevated from 500 to 700 feet above the sea, and hence the large streams have a total descent of from 300 to 500 feet. The Obion is navigable to Obion station, the North Forked Deer river to Dyersburg, the South Forked Deer river to the Louisville and Nashville railroad, but was once extensively navigated to Jackson.

The Big Hatchie is navigable to Bolivar. Steamers and "keel-boats" carry the produce of the land, except where the railroads have usurped their trade. The navigation is not stopped by the fall in the streams, but by drift-wood, snags, etc.

There is considerable fall in the upper waters of the main streams, and hence water-power. The rainfall averages 48 inches per annum. The rivers are subject to quite high floods; in 1854 the North Forked Deer river rose 24.5 feet at Dyersburg.

Utilized power.—There is a total of 1,690 horse-power used in the entire district, by about 100 establishments. These are grist- and saw-mills, with the exception of one woolen mill and one or two cotton-gins.

The following data are obtained from the census returns:

There are a saw-mill and a grist-mill on the Bayou de Chien, a small stream in Kentucky, each taking 20 horse-power under a head of 8 feet.

On the Obion are twenty-two grist-mills and three saw-mills, using 403 horse-power. The largest power used is 37 horse-power. The heads vary from 4 to 14 feet.

The Forked Deer has twelve grist-mills, one woolen-mill using 3 horse-power, and two saw-mills. The total power used is 234 horse-power, the largest is 30 horse-power, and the heads vary from 4 to 14 feet.

The Big Hatchie has five grist-mills, using 71 horse-power, with heads of from 4 to 7 feet.

The Loosahatchee has three grist-mills, two of 75 horse-power, under heads of 10 and 9 feet, respectively, and one of 25 horse-power, under a head of 7 feet.

The Wolf river has five grist-mills, using 74 horse-power, under heads of from 7 to 20 feet, and the largest power in use is 22 horse-power.

It is not probable that there will ever be any important water-power developments in this region, for the streams are small where the fall is greatest, and where the volume of water is large it flows with a gentle current in a rather low country.

EASTERN TRIBUTARIES OF THE MISSISSIPPI, FROM THE YAZOO TO THE MOUTH.

Drainage system.—All the streams which it is worth while to include under this heading are the Yazoo, the Big Black, the Big Pierre, and the Homochitto. They drain an area of about 19,000 square miles, thus distributed: Yazoo, 12,794; Big Pierre, 1,018; Big Black, 3,406; Homochitto, 1,201.

The region begins about at the northern boundary of the state of Mississippi, and extends 537 miles along the Mississippi river to the mouth of the Homochitto. The distance from the northern boundary of Mississippi to the Gulf is 872 miles. The region starts at the south with a width of 40 or 50 miles, but gradually widens to an extent of 110 miles. The average width of all but the southern third is from 80 to 85 miles. The total length is about 275 miles.

The Yazoo basin includes all the northern portion; then comes the narrow basin of the Big Black, extending for 150 miles along the southeastern side of the Yazoo basin, and then the comparatively small basins of the Big Pierre and the Homochitto.

The Yazoo is formed by the junction of the Tallahatchee and Yalobusha, and flowing into the Tallahatchee is the Coldwater river. These three principal tributary rivers of the Yazoo basin have the following drainage areas: Tallahatchee river, 5,711 square miles; Yalobusha river, 2,137 square miles; Coldwater river, 1,886 square miles.

General description of the country.—The region under discussion is the northwestern third of the state of Mississippi, and may be divided into two parts—the Yazoo bottom and the hill country. In describing the Delta of the Mississippi mention was made of the line of bluffs which mark its eastern limit; how they start from the river bank at the northern boundary of the state, and leave a strip of land from 40 to 60 miles wide, meeting the river again at the mouth of the Yazoo, 385 miles below. Then the bluffs skirt the river into Louisiana, passing east along the north side of lake Pontchartrain.

Between this line of bluffs on the one side and the Mississippi on the other, is the great Yazoo bottom, 170 miles long, and averaging 40 or 50 miles across. It is a vast low alluvial region, of unsurpassed fertility—the seat of great wealth before the civil war. Except a narrow strip along the Mississippi, all drains into the sluggish Yazoo by winding bayous and scarcely-moving streams. Heavy rains fill the rivers, so that with their little fall they can scarcely discharge the water poured into them; and were it not for the levees upon the banks of the Mississippi it would flood nearly the entire tract. This region is, of course, destitute of water-powers.

Back from the line of bluffs is the hill country, rising to its highest altitude along a north-and-south line, somewhat east of the center of the state. The surface is undulating and hilly, but nowhere mountainous. The highest elevation is thought to be about the sources of Pearl river, in the central part of the state, but probably does not exceed 800 feet above the sea. The sources of the large rivers are probably from 600 to 800 feet above the sea.

The highest ridges of the northern part of the state are, of course, between the sources of the Tombigbee on the east, and the Tallahatchee and Yalobusha on the west. The usual elevation of the hills above the minor water-courses is from 30 to 120 feet.

The topography takes its character from erosion in clay, gravel, and sand. The streams, especially the larger ones, have cut out considerable valleys, and flow through bottoms of some extent and fertility. Above the river bottom there is also fertile land, but a very characteristic feature is sand hills, covered with pines, "blackjack," and post oak. There is considerable timber of a better character—yellow pine, oak, hickory, elm, ash, etc.—and then in the southern part of the state is the immense forest of "southern pine", unsurpassed for size and value of timber.

Distribution of the power.—The boundary between the bottom land and the hill country, so far as it serves to define the water-power regions from those destitute of power, may be said to follow the line of bluffs down into Louisiana, and then east along the Gulf.

The rivers of the Mississippi which flow through the hill country have more or less water-power, which ceases as soon as they enter the low lands. A peculiarity of their basins, and, in fact, of the entire state of Mississippi, is that the utilized power is all on the small streams. There are no extensive developments of power—only small mills use it at all. The reason for this is partly lack of demand and of capital, but is also to be found in the nature of the streams themselves.

The rivers, where the volume is sufficient for a large power, have generally little fall, and very inferior banks and bed. The heaviest rainfall of the year is during late winter and spring, and then the streams are greatly swollen by freshets, which, without a rapid descent, would give trouble from back-water. The smaller creeks, on the contrary, are more easily controlled, have a more rapid descent, and are many of them remarkable for their extreme uniformity of flow. Rising among the sand hills, they are fed by never-failing springs, and at all seasons supply a steady power to mills located upon them. There are some cases in which small mills are run by streams almost within a stone's throw of the fountain head from which they spring.

The available powers of Mississippi are thus to be found upon the smaller streams, and not on the main rivers where they have obtained large size, unless in exceptional cases. There is not a large amount of water-power used in the state, and it is distributed among many establishments. According to the census returns, the largest power used is 80 horse-power, by a cotton-mill in the eastern part of the state. The total power used on the tributaries of the Mississippi from the Yazoo basin to the Gulf, inclusive, is not far from 850 horse-power, and of this 719 horse-power is on the tributaries of the Yazoo. The water-power of the state is utilized almost exclusively by flouring- and grist-mills, saw-mills, and cotton-gins, and the first are by far the most prevalent, especially in the Yazoo basin.

THE YAZOO AND ITS TRIBUTARIES.

The Yazoo itself has no water power, as it flows entirely in the bottom lands. It is sluggish and winding; back-water from the Mississippi extends up to Yazoo City, and the river forms a navigable channel throughout its length. The Tallahatchee and Yalobusha, which unite to form the Yazoo, join near Greenwood, in Le Flore county, after the Tallahatchee has meandered many miles south through the bottom lands. Below the junction there are no important streams entering the Yazoo from the hill country; the Big Black takes all the drainage in that direction.

TALLAHATCHEE RIVER.—One thousand eight hundred and eighty-six square miles of the 5,711 drained by this river belong to the Coldwater, which rises near the northern boundary of the state. The sources of the Tallahatchee are in the sandy, pine ridges which form the divide between the Mississippi and the Tombigbee, but most of its course is in a mixed soil of clay and sand.

The river is rather sluggish, with bottoms largely overflowed in high water, but in some places it flows close to the bluffs. Before the Chicago, Saint Louis and New Orleans railroad was built the river was kept open, and navigated, except in low water, up to Wyatt's, near the present line of the railroad, while in high water small boats ascended much farther. Now there is no navigation up the river. At the railroad crossing the river is some 75 feet wide in a good stage of water, with low timbered banks.

The channel is not very changeable, but the banks are badly overflowed, and the stream is not a good one for water-power, except near the sources, where it resembles the tributary creeks. There are four flouring- and grist-mills on the upper part of the river, using a total of 59 horse-power. The lowest is in Marshall county. The small tributaries have a number of mills upon them.

The Puscuss creek, meaning "Baby" creek, is a fine, steady spring stream, and has two flouring-mills and one saw-mill, with a total of 65 horse-power used, under heads of from 16 to 20 feet.

Little and Big Spring creeks are two small brooks with five flouring-mills upon them, using 58 horse-power.

Tippah river has one flouring-mill, using 12 horse-power.

Yocona river.—The Yocona river is the largest tributary next to the Coldwater. It rises near the waters of the Tombigbee, and enters the Yazoo bottom before uniting with the Tallahatchee. At the crossing of the Memphis and Grenada railroad, in the lower part of its course, it is 30 or 40 feet wide, with low banks. It much resembles the Tallahatchee in character, except that its banks are more unstable. At one place a mill fell to ruins owing to the caving of the banks. There is little, if any, available power except on the upper waters and the tributaries, where are some mills.

Coldwater river.—The Coldwater rises west of the center line of the state, flows west to the Yazoo bottom, and then south to its junction with the Tallahatchee. About half its course is in the Yazoo bottom. It is unnavigable, and is unadapted to use for water-power except in its upper portion. In Marshall county, on its upper waters, are three flouring-mills, using 81 horse-power under heads of from 4 to 8 feet, but there is no utilized power below.

YALOBUSHA RIVER.—The Yalobusha has a more nearly westerly course than the Tallahatchee, and unites with it after 25 or 30 miles of passage through the Yazoo bottom. It is navigated in the rainy season to Grenada on the

Chicago, Saint Louis and New Orleans railroad, where it is about 100 feet wide in ordinary stages, with sandy rim-banks from 3 to 5 feet high. The banks and bed are chiefly of a rather sandy clay or gravel, and high water floods far back over the bottoms. The testimony is that it is a sluggish stream, and not adapted for water-powers on this account, and because of the freshets to which it is subject.

At Benela, near the headwaters, is the only mill on the river, a small flouring-mill, using 10 horse-power, under a head of 8 feet, and the one cause of stoppage is back-water when the river is high. As in the case of the Tallahatchee, the best available power is near the source and upon the small tributary streams, which are many of them rapid.

Loosaschoona river.—About 4 miles above Grenada the Loosaschoona river enters from the north. It is longer than the main river above the junction, but drains somewhat less territory. Like the Yalobusha, its available power is mostly at the upper part and on the side streams; but in places the bluffs approach close to the banks, giving available sites. There is only one improved power on the river itself; this is employed by a flouring-mill northwest of Pittsborough, using 16 horse-power under a head of 10 feet. The owner writes that the wheels are frequently drowned for one or two weeks at a time in the high water of winter and spring, owing to the lack of fall below the mill.

THE BIG BLACK, BIG PIERRE, AND HOMOCHITTO RIVERS.

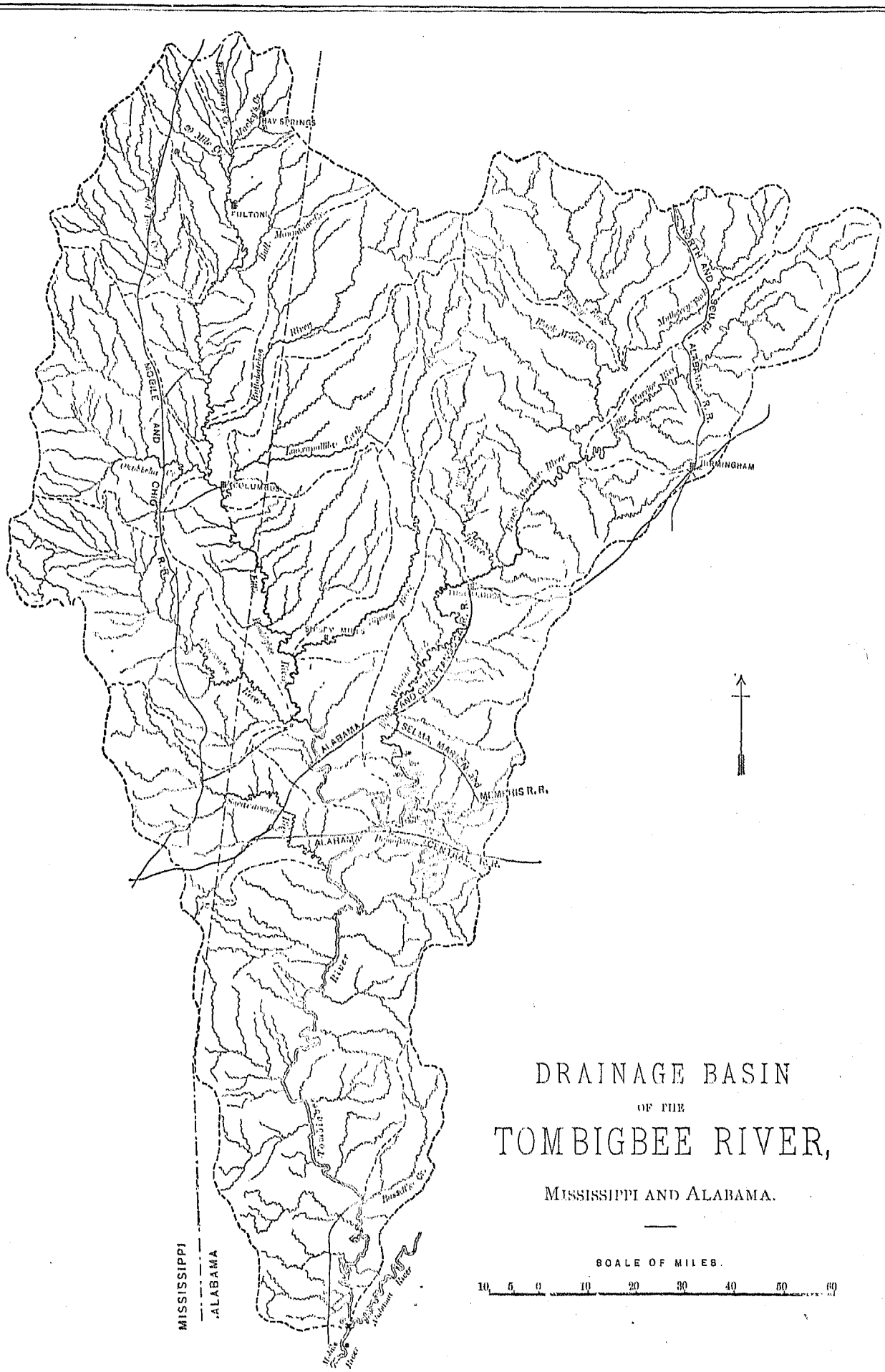
These streams enter the Mississippi where it runs close to the line of bluffs, and hence have no long courses through bottom lands, except such as they have themselves created.

The Big Pierre and the Homochitto may be dismissed with a passing notice, as in the entire region drained by them there is only one small flouring- and grist-mill, using 15 horse-power from a tributary of the Homochitto. They probably have many small undeveloped powers at their upper waters, as do the other rivers of Mississippi.

The Big Black basin is wedged in between the basin of the Pearl on one side and of the Yazoo on the other. It averages about 23 miles wide, and extends northeast as a straight, narrow strip of land for 150 miles, to the divide from the Tombigbee river. The river is scarcely navigable to Way's Bluffs, on the Chicago, Saint Louis and New Orleans railroad. It is sluggish, overflowing its wide bottom lands, and is unfit for water-power except in the upper part.

All the water-power used in the basin is in the northeastern half, with the exception of 26 horse-power taken in Madison county. In Choctaw county there is 41 horse-power used, and in Attala county 46 horse-power, making a total of 113 horse-power.

On the river itself there are five flouring-mills and one saw-mill using water-power, and four of these establishments are in Choctaw county. The total power used from the river is 87 horse-power, the total power of the basin less that in Madison county. One of the flouring-mills in Attala county is credited in the census returns with the use of 40 horse-power under a head of 10 feet, the largest water-power used in the Mississippi basin in the state.



DRAINAGE BASIN

OF THE

TOMBIGBEE RIVER,

MISSISSIPPI AND ALABAMA.

SCALE OF MILES.

10 5 0 10 20 30 40 50 60

THE RIVERS OF THE GULF OF MEXICO IN LOUISIANA AND MISSISSIPPI, AND THE TOMBIGBEE IN ALABAMA.

GENERAL DISCUSSION.

From the Sabine, which separates Louisiana from Texas, to the Alabama river, there are only six rivers of much importance, exclusive of the Mississippi and its numerous bayous.

These are the Calcasieu river, draining 3,410 square miles; the drainage system of 1,830 square miles, represented chiefly by the bayou Nezpigue; and east of the Mississippi, the Amite river, draining 1,880 square miles; the Pearl river, draining 8,670 square miles; the Pascagoula, draining 8,350 square miles; and the Tombigbee, which unites with the Alabama to form Mobile river and drains an area of 21,917 square miles.

Distribution of the power.—The line of division between the delta of the Mississippi and the high land crosses the Sabine river at Orange, passes east, about 30 miles distant from the Gulf, to bayou Têche, runs along the west side of the bayou to the Red river, which it crosses at Alexandria, and so passes up the Mississippi. Its course down the east bank of the Mississippi and then east a few miles north of lake Ponchartrain has been already described.

In the Delta the land is low and swampy, and vegetation almost tropical in its luxuriance. The highlands consist largely of "piney-woods lands", where the soil is clay, sand, and gravel.

The rivers, as they flow from the highlands, have a rather rapid descent over gravelly and sandy beds in their upper parts, gradually assuming a more sullen appearance as they increase in size; the beds are more obstructed with snags and fallen trees, the shoals are largely due to sunken logs causing gravel deposits, the heavily-wooded bottoms, which are overflowed in high water, increase in width, and finally they wind through the swamps of the Delta, where even the small tide of the gulf of Mexico extends far up their courses.

As a means of navigation from the pine and live-oak forests of southern Mississippi and Louisiana, and the fertile plantations, these rivers and bayous are of great value, and the late Major C. W. Howell, U. S. engineers, stationed at New Orleans, was engaged in the work of improving them for that purpose. As a means for furnishing power, so much cannot be said, for the smaller of these streams at any rate.

Of water-power there is only 73 horse-power used in the Gulf drainage of Louisiana, under heads of from 5 to 7 feet, and 47 horse-power of this is in or near the Amite basin. This is not because small available water-powers do not exist there. In the "piney-woods lands", the same as in the "hill country" of Mississippi, just described, the river valleys have a rapid descent, and undoubtedly there are available powers on the small streams of the highlands, where there are no extensive bottom lands to deal with, and heavy floods would not destroy all head of water. The reason for no use of water-power probably is that for lumbering, etc., steam-power is very cheap, and far more serviceable than any water-power that could be obtained.

With the rivers which rise far up in the hill country of Mississippi the case is somewhat different, and even the smaller ones, the Amite and Tangipahoa, which rise in Mississippi between the Mississippi and the Pearl river, have some small mills at their sources. Like the Big Black and the streams of the Yazoo basin, the Amite, the Pearl, and the Pascagoula are characterized by small developed powers upon their tributaries and upper waters, but by none upon the large streams.

The census returns credit the Amite basin in Mississippi with 224 horse-power utilized, and of this 88 horse-power is used on the river itself by five flouring-mills and three saw-mills. Within the basin in Louisiana there are three flouring-mills, using a total of 18 horse-power, but no power is taken from the river itself.

From the Tickfaw river, which flows between the Amite and the Tangipahoa, there is 29 horse-power used in Louisiana by three flouring-mills and one saw-mill. There is 74 horse-power in use in the Tangipahoa basin, 38 horse-power by two flouring-mills on the main stream, but there is no power utilized in the basin in Louisiana.

In the upper part of its course in Louisiana the Amite averages 100 feet wide, with a least depth of 1 foot, and an average low-water velocity of 1.4 foot per second. The Tangipahoa runs from 50 to 100 feet in width, with a least depth of 1 foot. The Calcasieu, at Phillips bluff, about 80 miles above its mouth, is about 70 feet wide, with 1 foot depth of water on the shallows.

Having now disposed of the streams west of the Pearl, the basins remaining to be described are those of the Pearl, the Pascagoula, and the Tombigbee. The latter embraces such a variety of country as to necessitate a short separate description.

The first two rivers rise in the highland of Mississippi, especially the Pearl, about whose sources is probably to be found as high an elevation as any in the state. They both flow through the great forest of long-leafed pine, and the basin of the Pascagoula lies entirely within it, as marked out upon the forestry map compiled by Mr. C. S. Sargent, special agent of the census. The pine has been cut near the streams, where it can be easily rafted down to the Gulf, but back from them are vast bodies of the finest timber.

THE PEARL RIVER.

The name of this river was derived from the purity of its waters when nature was allowed her course; since navigation became important, "cut-offs" have been made, the regimen of the river has been disturbed, and it is now a muddy stream, with a rapid current in high water, eroding the banks and causing much damage to property, besides impeding navigation by drift-wood. The United States engineers are endeavoring to improve the state of affairs, and a better idea of the river can scarcely be obtained than from the report made by Mr. H. C. Collins, assistant engineer to Major Howell.

The basin is about 200 miles long, and maintains a width of 40 or 50 miles for nearly the entire distance. The river is navigable to Carthage, 417 miles above its mouth, and the source cannot be much less than 75 miles above Carthage. At Carthage the stream is 170 feet wide, and rises 18 feet above low water, filling the valley. From there down to Jackson, 102 miles below, it has a current of from 1 to 1½ mile per hour, with a 7-foot rise. At Jackson there are bluffs which so restrict the flow that in the extraordinary high water of 1874 the river rose 57 feet above extreme low water; at many places below it rose nearly as high.

Distribution of the power.—As can be readily understood, there are no really available water-powers on the main river, except far up toward the headwaters. By cutting across the numerous bends falls could be obtained, and one of 20 feet is claimed for a bend of 15 miles at Jackson; but such powers as these, if they were not rendered entirely valueless by the floods and back-water, would interfere with the flow of the river for navigation. There is not a mill on the main river using water-power, but on the tributaries there are several, making the total utilized power of the basin 699 horse-power.

The sources are in the pine ridges which form the water-shed between the Pearl and the Tombigbee, and hence the head-streams are very steady and are valuable for small powers. The greater part of the utilized power is on the small creeks; the larger tributaries have few mills, although there are available sites on some of them. The Yokahockony, Tuscalameta, Strong river, and Bogue Chitto are the principal tributaries. According to the census returns the Yokahockony has two flouring-mills, using 30 horse-power, and also two saw-mills, using the same amount, which are, however, only attachments to the flouring-mills. There are several available powers upon the river, one near Kosciusko, with a head of about 10 feet.

The Tuscalameta has no utilized power, and although a rapid stream, has very unstable banks and is unsuitable for power.

The Strong river has two saw-mills, using 36 horse-power. The Bogue Chitto has two flouring-mills, using 18 horse-power.

The distribution in horse-power of the utilized power of the basin according to counties is thus: Choctaw, 30; Neshoba, 185; Copiah, 28; Attala, 32; Rankin, 22; Lincoln, 22; Leake, 144; Simpson, 116; Lawrence, 120.

THE PASCAGOULA BASIN.

This embraces the region between the Pearl and the Tombigbee. The basin is 8,350 square miles in extent. The mouth of the Pascagoula is only 40 miles in a straight line from its head, where it is formed by the union of the Leaf river from the west and the Chickasawhay from the east. The first drains 3,585 square miles, and the second, 2,985 square miles. The Chickasawhay extends far north to the center of the state, and divides near the sources into the Chunky and Oktibbeha creeks. Sixty-two square miles of the basin of the Chickasawhay are situated across the state line in Alabama.

Distribution of the power.—Little is to be said for the water-power of the Pascagoula basin, beyond a repetition of the preceding remarks on the hill-country streams. The main rivers are subject to rapid fluctuations in volume, and overflow their bottom lands, so that practically no water-power is available upon them, except at the headwaters. The Chickasawhay has been navigated by a small boat clear to its head, where the Chunky and Oktibbeha unite. The side streams, especially the larger ones, descend from the high pine lands with rapid fall, and furnish many fine powers, very little developed.

On the Leaf river there is one saw-mill, using 6 horse-power. Tallahala creek, one of its chief tributaries, has one flouring-mill, using 10 horse-power.

The Bogue Homo has one flouring-mill, with 6 horse-power, but Okatoma creek, the remaining large branch, has no mill upon it.

The Chickasawhay river has no utilized power. Its largest tributary, Buckatunna creek, has no mills. The Oktibbeha creek has two flouring-mills, using 53 horse-power.

Between Oktibbeha creek and Chunky creek, at their junction, is one of the largest available heads of water in the state. A small stream flows into the Chickasawhay at that place, and by diverting it over a rock declivity into the Chunky a fall of 70 feet is made available. About a quarter of the power is used by three overshot wheels of 16 feet diameter, ranged one below the other. This power is very poorly developed.

The total power used in the Pascagoula basin is 878 horse-power, thus distributed by counties: Newton, 83; Jasper, 54; Jones, 28; Lauderdale, 310; Clark, 65; Wayne, 67; Smith, 141; Covington, 83; Perry, 47.

THE TOMBIGBEE RIVER.

System of drainage.—Of the 21,917 square miles drained by the Tombigbee about one-third lies in Mississippi and the remainder in Alabama.

The basin starts from a point at the head of Mobile river, where the Tombigbee unites with the Alabama, and gradually widens, with its axis of symmetry nearly a north-and-south line, until at its upper part it reaches a width of 160 miles, extending more than two-thirds of the distance across the state of Alabama. The axis is about 230 miles long, and the head of the basin is determined by the line of water-shed of the Tennessee, the great tributary of the Ohio.

The name Tombigbee is stated to be a corruption of the Indian name Etomba-Igaby, or Box-Maker's creek, given by them to a small tributary, because an old coffin- or cabinet-maker lived on its banks. The river is locally called the "Bigby".

At a distance of 194 miles from the junction with the Alabama it is formed by the union of the "Little Bigby", from the west, and the Black Warrior, from the east. The former drains 9,189 and the latter 6,500 square miles, so the Little Tombigbee is properly the continuation of the main river. These two large forks flow comparatively near the west and east lines of water-shed, respectively, and the crest-line between them does not vary greatly from a straight line passing a little east of north to the Tennessee watershed.

The Little Tombigbee crosses the line between Mississippi and Alabama about 140 miles above its junction with the Black Warrior. It is formed by a number of small creeks in northeastern Mississippi, of which Brown's and Macky's creeks are the chief. The distance from the mouth to Cotton Gin Port is 236 miles, and the junction of Brown's and Macky's creeks may be safely estimated at 50 miles farther up-stream.

The Black Warrior is formed 261 miles above its mouth by the junction of the Sipsey and Mulberry forks, draining, respectively, 1,067 and 582 square miles of territory, so that the river starts off with a tributary area of 1,649 square miles.

The main river, below the union of the Little Tombigbee and the Black Warrior, drains 6,228 square miles, and its chief tributary is the Sacomochee river, on the west. The principal western tributaries of the Little Tombigbee are the Okanoxubee, Oktibbeha creek, and Old Town creek; and those on the east are the Sipsey river, Looxapallila creek, and the Buttahatchee river. The chief branches of the Black Warrior are the Sipsey and Mulberry forks and the Little Warrior, entering from the left.

The following table gives the drainage area of the main stream at various points, considering the Little Tombigbee as its continuation:

Drainage areas of the Tombigbee river.

Station.	Drainage area above station.	Station.	Drainage area above station.
	Square miles.		*Square miles.*
Junction of Brown's and Macky's creeks..	312	Below Okanoxubee river	8,718
Below Old Town creek	1,070	Above Black Warrior river.....	9,189
Below Buttahatchee river	3,288	Below Black Warrior river	15,689
Below Oktibbeha creek.....	4,520	Below Sacomochee river	18,212
Below Looxapallila creek	5,377	At the head of Mobile river	21,917
Below Sipsey river	7,229		

Drainage areas of tributaries of the Tombigbee river.

River.	Drainage area.	River.	Drainage area.
	Square miles.		*Square miles.*
Old Town creek	688	Sipsey river	763
Buttahatchee	887	Okanoxubee river	1,408
Oktibbeha creek.	1,143	Black Warrior river	6,500
Looxapallila creek.....	818	Sacomochee river.....	2,441

The Black Warrior has been already stated to drain 1,649 square miles at the junction of the two forks. Below the mouth of the Little Warrior it drains 3,691 square miles, and 4,941 square miles at the town of Tuscaloosa. The Sipsey fork drains 1,067 square miles, the Mulberry fork 582 square miles, and one large tributary, the Little Warrior river, drains 1,218 square miles.

General description of the country.—The country drained by the Tombigbee is nowhere mountainous, strictly speaking, but is undulating or hilly, and owes its topography chiefly to erosion by its water-courses. This is true of all but the eastern extension of the basin, where the Black Warrior rises among the extreme spurs of the great Appalachian system of upheaval as they subside into the undisturbed strata of southern and western Alabama.

The higher elevations of the line of water-shed are probably not over 800 or 1,000 feet above sea-level, and the general level of the upper part of the basin is probably 600 or 800 feet above the sea.

The southern and western parts of the basin are very similar in their general characteristics to the greater part of the state of Mississippi; a rather sandy, gravelly soil—the modified drift brought down by the ancient floods from the north—in some places fertile and in others characterized by "blackjack ridges", alluvial bottoms along the larger water-courses, and heavy bodies of timber; nor must the extensive tract of northern pine in the lower part of the basin be overlooked.

The eastern extension, occupied by the Black Warrior and its tributaries, has a different nature. Above Tuscaloosa the river flows through what is known as the Warrior coal-basin. The country, on the north side of the river more especially, is very rough and rocky, poorly covered with drift, and this with hard wood and stunted pine, and is mainly unfit for cultivation. There are some small fertile bottom-lands along the streams, but these are liable to overflow. The land about the southern tributaries of the Warrior is somewhat better than that northward.

The wealth of this region lies in its valuable beds of bituminous coal, hardly disturbed as yet. A few coal companies have been formed, and two railroads—the Alabama and Chattanooga, and the South and North Alabama—intersect the coal-fields, but the development of the "Warrior basin" is still in its infancy. And this important feature is the existence of valuable iron ores, almost touching the beds of coal. At Birmingham, where the two railroads cross, a mountain on one side of the valley is formed of iron ore, and on the opposite side is the coal for reducing it.

The United States government has had surveys made with a view of extending the navigation of the Black Warrior above Tuscaloosa to the forks by means of dams and locks.

Distribution of available power.—The basin of the Tombigbee presents sharp contrasts; the semi-tropical bottom-lands, with their heavy foliage and sullen rivers, and the sterile, rocky ridges and rapid streams; the exhausted farms of northeastern Mississippi, now covered with small pine, but once rich plantations, and the wild, undeveloped region of Alabama, with scarcely a pioneer hut within it.

The natural navigation is continuous from Mobile, at the level of the Gulf, for about 270 miles, to Fulton, almost at the head of the Little Tombigbee, where small boats go for the cotton trade, and for 169 miles to Tuscaloosa, on the Black Warrior, where the river leaves the coal-basin.

Immediately above Tuscaloosa the slope of the Black Warrior increases, rapids characterize the stream, and it becomes unnavigable. The United States engineers stationed at Mobile, of whom Major Damrell is chief, find it a very different problem in dealing with the upper Warrior from training the lower part of the river and the Tombigbee. On the one the work consists in removing bars, snags, and leaning trees; on the other it will be, if ever undertaken, the building of locks and dams to overcome the rise in the bed.

The available water-power outside of the Warrior coal-basin is on the tributary rivers and creeks. As throughout the state of Mississippi, the large streams flow with a comparatively gentle current, with a low bank on one side or on each side, broad bottoms, overflowed in high water, and loose bed and banks. The side streams largely rise among the sand hills, which store the abundant rains of this parallel and feed the water-courses with a steady supply. From these hills they flow with a rapid current to the main rivers.

The nature of the powers is not essentially different from that of those streams in Mississippi already described, and, indeed, they are many of them only separated by a slight change in level of the same ridge. The most rapid streams, however, and those offering the greatest number of water-powers, are the eastern tributaries of the Little Tombigbee, such as Bull Mountain creek, the Buttahatchee, etc.

Within the Warrior coal-basin the rivers and their tributaries have more the features of mountain streams—not torrents, but rapid—and the Black Warrior itself has rapids and an immense amount of water-power. There are disadvantages belonging to the water-powers of this region not shared to much extent by the other powers of the Tombigbee basin. The water flows rapidly off of much of the rocky, sterile soil, leaving such streams as are fed from it to fall very low in dry weather and filling them to overflowing in rains. Some of the tributaries on the south side of the Black Warrior are fed by springs and are better in this respect; some of them are even fine spring streams. The sources of the main river are sterile, without swamps or many springs, and the river is "flashy".

The great floods to which the Black Warrior is liable practically debar the use of the largest otherwise available powers of the Tombigbee basin. The heavy rains to which the region is subject—from 45 to 55 inches per year—fill the channel of the river from September more or less of the time until April, and sometimes in summer there

are floods washing out the crops along the bottom lands. The high-flood rise is from 15 to 60 feet, according to the locality, and this makes the development of some of the powers impracticable. But the main reason for the undeveloped condition of the powers of the coal region is the entire absence of any demand for them, and it is difficult to see how a demand shall ever exist, unless water-powers should become so valuable as to attract crude material to them.

There is no production of cotton, wool, or other material to warrant the erection of manufactories, except about the outskirts of the region, and there is scarcely a prospect of any being produced within it; and even if there may be in time much demand for power, the cheap coal will be a powerful competitor of the water-powers. However, without a thorough examination it would be hazardous to say that there are no sites upon the Black Warrior river where, by leading the water out of the way of floods, a large head could always be obtained and buildings safely located at a reasonable expense; and the next half century may see some extensive cotton factories run by the power of the river, and manufacturing at home the cotton which has been carried hitherto to New England.

The same financial advantages regarding their relation to the cotton fields which are set forth by Prof. Swain for the South-Atlantic water-powers will apply to the eastern rivers of Alabama, and among them it is perhaps proper to include the Black Warrior. While upon this subject, it may be stated that outside of the region of large water-powers in the parts of Mississippi and Alabama already discussed, there are many available powers of from 50 to 200 horse-power or more, where small cotton and woolen factories or other industries may be started and very profitably carried on.

Distribution of utilized power.—Before giving, so far as possible, the individual features of the principal streams of the basin, a statement will be made of the utilized power as given in the census returns.

The total utilized water-power is about 2,614 horse-power, 736 in Mississippi and 1,878 in Alabama. In the basin of the Little Tombigbee there is 1,162 horse-power in use, 644 in Mississippi and 518 in Alabama, and 1,161 horse-power is utilized in the basin of the Black Warrior. Two hundred and ninety-one horse-power is used in the basin of the main river below the mouth of the Black Warrior. The power in use is thus distributed by counties:

Counties in Mississippi:	Horse-power.	Counties in Mississippi:	Horse-power.
Prentiss	53	Lowndes	74
Tishomingo	57	Oktibbeha	40
Lee	150	Winston	58
Itawamba	28	Noxubee	105
Chickasaw	11	Kemper	92
Monroe	68		

Counties in Alabama:	Horse-power.	Counties in Alabama:	Horse-power.
Lawrence	20	Walker	195
Marshall	24	Jefferson	256
Etowah	21	Pickens	67
Blount	267	Tuscaloosa	237
Winston	61	Hale	90
Marion	72	Sumter	10
Lamar	334	Choctaw	44
Fayette	25	Clarke	155

There is a total of 190 establishments using water-power in the Tombigbee basin; 154 flouring- and grist-mills, 27 saw-mills, 4 cotton-gins, 2 woolen-mills, 1 cotton factory, and 2 manufactories of leather. Of these establishments, 137 are in Alabama and 53 in Mississippi, as follows:

State.	Flouring- and grist-mills.	Saw-mills.	Cotton-gins.	Woolen-mills.	Cotton factories.	Leather manufactories.
Alabama	108	23	4	2	.....	.....
Mississippi	46	4	.....	.....	1	2

The powers on the principal streams are compiled from the census returns, as follows:

The Tombigbee and Little Tombigbee have no utilized water-power.

The Buttahatchee river has five flouring- and grist-mills, using 70 horse-power, under heads of from 3 to 20 feet.

Old Town creek and Tibbee creek have no improved powers.

Looxapallila creek has two flouring- and grist-mills, using 22 horse-power, under heads of 7 and 15 feet, and one saw-mill, using 16 horse-power, under a head of 14 feet.

Sipsey river has three mills.

Okanoxubee river has two flouring- and grist-mills, using a total of 40 horse-power, under heads of 6 and 9 feet.

Sacamochee river has no utilized power.

The Black Warrior proper has 62 horse-power, used by three flouring- and grist-mills and one saw-mill below Tuscaloosa. All have a head of 8 feet but one.

The Sipsey fork of the Black Warrior has two flouring- and grist-mills, using a total of 28 horse-power, under heads of 30 and 7 feet.

The Mulberry fork of the Black Warrior has two flouring- and grist-mills, using 50 horse-power, and a saw-mill with 20 horse-power. The heads are 10, 7, and 6 feet.

The Little Warrior has three flouring- and grist-mills, using 50 horse-power total, under heads of from 6 to 12 feet; two saw-mills, using 27 horse-power, under heads of 7 and 10 feet; and one woolen-mill, for which the head is unrecorded, using 8 horse-power.

Considering the main stream to extend from the junction of Brown's and Macky's creeks to the junction with the Alabama, the Tombigbee has not a water-power in use upon it. The banks are low as a usual thing, and the stream has a rather sandy bed, which conditions render it poor for the utilization of power, let alone the floods to which it is subject.

In flush stages small steamers run even to Fulton, in Mississippi, and a flat-bottomed steamboat about 200 feet long makes trips during the late winter and spring to Aberdeen, 470 miles from Mobile. At Fulton the river runs on the west side of a heavily wooded, swampy bottom-land, from 1 to 1½ mile wide, and is itself about 150 feet in width, with a strong, silent current, deep and dark. The west bank is steep and firm, but the east is swampy.

At Columbus, 36 miles above the crossing of the state line, the river is about 300 feet wide, with rim-banks some 10 feet high. These are in some places of clay and in others a fine sand. Beside the river at this place there is some clean white sand, which rivals in purity the remarkable Saint Peter sandstone found in Minnesota and Wisconsin. At the crossing of the Alabama Great Southern railroad, some 45 miles above the mouth of the Black Warrior, the river when seen in a high stage was 400 or 500 feet wide between the natural banks, but had overflowed the low eastern bank and flooded the bottom land, which is timbered. The west bank is a bluff about 30 feet high, consisting chiefly of a light-gray rock, probably limestone.

Sources of the Tombigbee.—The sources of the Tombigbee are, strictly speaking, Brown's and Macky's creeks. These drain together 312 square miles, of which Brown's creek has rather more than half. Brown's creek divides into Big and Little Brown's creeks and Hurricane creek. Brown's creek near its mouth is 25 or 30 feet wide in the shallow places, with a depth at such points of from 1 to 1½ foot, and a rapid current. Macky's creek at Bay Springs, where about half its drainage area is tributary to it, is from 25 to 40 feet wide, from 3 to 5 feet deep, and with a moderate current.

These and the neighboring streams usually have a freshet in the fall, and along through the winter and spring are subject to more or less high water; but they do not have such immense rises as occur on the large rivers, probably on account of the sand ridges, and the swamps, in which a greater proportion of the flood-water is held back than along the main streams.

On these streams are many available powers, and numerous small mills which do local grinding, chiefly of corn, and a few have a saw-mill addition. The census returns show four flouring- and grist-mills on Brown's creek, using 45 horse-power, all under a head of 5 feet, and 57 horse-power used by three flouring- and grist-mills and two saw-mills on a stream entitled Spring creek, which is probably Macky's creek.

Bay Springs, on Macky's creek.—At Bay Springs, on Macky's creek, is probably the finest power in that section, if not in the state. It is the most extensively developed power of the entire region, but is by no means fully improved. The little village of Bay Springs consists of the manufactories, store, and house of Mr. Nelson, the proprietor and operator, and the few dwellings of the workmen.

On the left bank is a cotton factory, and on the east bank is a grist- and saw-mill, with a cotton-gin and one or two other small attachments. A peculiar feature of the place is the appearance of rock, and the buildings are set on solid sandstone. The creek runs through a gorge, with rocky cliffs about 150 feet apart and 30 feet high. These and the solid rock bed make the situation admirable for the dam, which is a framed structure, giving a head of 11 feet to the mills set directly at its stone abutments. The head could be increased to 30 feet, and it is claimed that this would not flood land of any considerable value above. Probably the land could be readily bought for two dollars per acre.

The cotton factory has a 55-inch turbine, and on the other side is a 50-inch wheel, besides three others of from 16 to 27 inches, used at times to drive the small machines mentioned. The wheels are not run at full capacity, and there is abundance of water for all the work now done with the present head. Mr. Nelson claims that with a head of 30 feet there would be 500 horse-power available most of the year, but probably during the dry season it would not be over 150 or 200 horse-power. There is no trouble from back-water, as the flow passes rapidly down the gorge. If the water is ever carried any distance down-stream from the dam it will have to be taken in flumes, or else in races blasted out of the rock. The head of 30 feet would raise the level about to the crest of the gorge. Unless extensive improvements are undertaken it seems preferable to set the wheels at the dam, and to transmit the power by wire-rope or shafting.

One great advantage which makes this power almost unique among those of Mississippi is the extensive exposure of solid rock in the bed and banks, and the excellent building-stone afforded for dam and buildings. The rock is a light grayish sandstone of rather fine grain, which works easily and is considered to be excellent

stone. Where exposed to the weather the angles are sharp, and the cliffs show that it breaks in true bedding planes and in large straight blocks. Iron stain shows in places, but the abutments of the mill dams, built of this stone, have weathered with a rather pleasing tint. Judging from appearances, the stone could be quarried over a large tract, and if near a market would undoubtedly be valuable. The distance from the Mobile and Ohio, and also from the Memphis and Charleston railroad, is about 20 miles, over which branch roads could be easily constructed.

There was once a mill on Macky's creek, several miles below Bay Springs, with 11 feet head of water. One bank there is high, but the other is low and expensive to maintain.

Twenty-Mile creek enters from the west, and although draining about 200 square miles, has low sandy banks and is not adapted to water-power.

Bull Mountain creek is a stream rising in Alabama and draining some 360 square miles. It is described as a good stream, with several fine unimproved water-powers upon it.

Old Town creek runs chiefly through swamps, with low banks, and is not adapted for water-power except perhaps at the sources. At the levee, in the swamp near Tupelo, it is not over 25 or 30 feet wide, but runs with a good current and is claimed to be 30 feet deep at that place. It is a characteristic of these streams that they carry more water than would appear at first sight, owing to their depth.

Buttahatchee river.—The Buttahatchee drains 887 square miles, and is a fine, strong stream, with considerable fall, and several mills already mentioned, besides undeveloped powers. The bed and banks are usually of sandy clay and gravel. The high rises to which the Little Tombigbee is subject back about 6 miles up the Buttahatchee. It is considered rather steadier in flow than the neighboring streams, and it is usual to calculate upon about 50 horse-power with a head of 5 feet, although part of the year there is much more. The eastern tributaries of the Little Tombigbee are considered as a rule more reliable than those from the west, because the latter are to a considerable extent lost by evaporation and filtration in the swamps, which are too large for them, and in the sandy soil. This is somewhat the state of affairs on the east side of the river also. Thus, Lubbub creek, which enters below the Looxapallila and drains about 345 square miles, has more volume in the upper part than near the mouth. It has a few mills upon it obtaining about 30 horse-power under a head of 8 feet.

Oktibbeha creek drains 1,143 square miles, but has no mills upon it, little if any available power, and is almost lost in the bottoms near its mouth. Where the Mobile and Ohio railroad crosses it is difficult to distinguish the creek from the sloughs into which it spreads.

Looxapallila river.—The Looxapallila drains 818 square miles, and has several mills upon it, besides powers that are undeveloped. It enters the Little Tombigbee below Columbus, and near its mouth is 75 or 100 feet wide, with a steady, moderate current and sand and gravel banks.

One of the best mills in this section is the Jamieson mill, 9 miles from Columbus. Two and a half miles up-stream a pile-dam has been built across, turning the water into a race to the mill. A head of 16 feet is available, and 14 feet is used. There is 75 horse-power used by the mill, and the proprietor claims that at least 100 horse-power can be depended upon with the full head of 16 feet. Judging from the size of the river, this estimate seems small. Allowing an average low flow of only 0.3 cubic foot per second per square mile, and this is a low estimate for the region, gives over 400 theoretical horse-power under a head of 16 feet.

The high water is usually from January into April, and sometimes in December. The banks and bed are of sand and gravel, which characterize the stream. Usually there is one high bank and one low one.

According to a line of levels run, the river at the Jamieson mill is 56 feet above low water at its mouth, some 15 miles distant along the channel, and yet the high rises on the Tombigbee back the water up nearly to the floor of the mill. This lasts only a short time, as it is the result of the extreme rise on the main river.

All powers below the Jamieson mill are, of course, practically useless.

Sipsey river.—The Sipsey basin is 763 square miles in extent, and lies wholly in Alabama. It is about 90 miles long, and does not average over 10 miles wide.

The river rises in a rough, broken country, and flows through it between rocky bluffs for 40 or 50 miles. Then for about 95 miles (United States engineers' reports) the banks are steep soil bluffs, from 5 to 15 feet high, and then blue limestone is met, and the river is bounded by rocky bluffs for the remaining 22 miles to its mouth. The total fall in the last 145 miles from the north line of Fayette county is 85 feet. The average width of the stream is from 50 to 80 feet. The river was declared navigable by the legislature in 1837, and a company chartered to navigate it, but the right was reserved to erect dams so that they did not interfere with navigation. One-hundred-ton flatboats can navigate the river for from three to six months of the year. They float directly over the crests of the dams, and carry chiefly coal and cotton.

There are seven mill-dams, in a more or less dilapidated condition, but only three mills are working. These are the Sipsey mills, 9 miles from the mouth, and two mills in Fayette county, on the upper part of the river.

The Sipsey mills have a head of 7 feet, and the best improved power on the river; there is a flouring- and grist-mill, with six runs of stones, a saw-mill, and a cotton-gin. The next power has a flouring- and grist-mill and a cotton-gin, with a head of 4½ or 5 feet. The last power has a grist- and a saw-mill, with a head of 6½ feet, and ranks next to the Sipsey mills in importance.

The rim-banks of the river are usually sandy clay and gravel, and generally this forms the bed, but in some places there is solid rock. Floods take some time in disappearing, and back-water is a disadvantage to powers. The mills are hindered from one month to three months in winter and spring from this cause. As on the other streams of this region, there are freshets in winter and spring, sometimes from November on. The range between low and high water at the Sipsey mills is from 25 to 27 feet. Floods on the Little Tombigbee back 2 miles up the Sipsey. With a head of 8 feet at least 100 horse-power can be depended upon in the lower part of the river.

For the first 15 or 20 miles above the mouth the banks are high, and the river runs rapidly, giving available powers. At the head of back-water from the Little Tombigbee there is an available head of 8 feet. Above that for many miles the stream is more sluggish, and any available power would be under great disadvantage from back-water. Beyond this at the head-waters the river is rapid once more.

Okanoxubee river.—The Okanoxubee river drains 1,408 square miles, lying mainly in Mississippi. It is a rather sluggish stream, and has only two flouring- and grist-mills, situated on its upper part, and using 15 and 25 horse-power, under heads of 6 and 9 feet, respectively. The sources are among the sandy pine ridges, and give fine powers. The Hashugua cotton-mills, at Fern Springs, have a head of 11 feet and wheel-capacity for 80 horse-power.

Sacamochee river.—The Sacamochee river drains 2,441 square miles, and enters the main Tombigbee below the Black Warrior. It has no improved power, and there is very little, if any, within the basin.

Bassett's creek, in Clarke county, is the only water power stream of special note entering the Tombigbee below the Black Warrior. It drains about 290 square miles. Upon it are three flouring- and grist-mills, using 8, 10, and 8 horse-power, under heads of 10 and 11 feet, respectively, and one saw-mill, using 30 horse-power, under a head of 12 feet, as given in the census returns.

BLACK WARRIOR RIVER.

The name Black Warrior is derived from the Choctaw name Tuscaloosee (*Tusca*, warrior, and *loosee*, black).

The river's drainage basin of 6,500 square miles is divided into 1,067 square miles, drained by the Sipsey fork; 582 square miles, drained by the Mulberry fork; 1,218 square miles, drained by the Little Warrior, called by some the Locust fork; and 3,633 square miles, drained by the smaller tributaries, of which none drain more than about 300 square miles. North river is one of the largest.

Mention has been made of the United States engineers' surveys for the improvement of the river by slack-water, the great rises to which it is subject, the rapid descent in places, and the disadvantages under which the water-powers are placed.

A United States survey made by Professor E. A. Smith, state geologist, and then assistant United States engineer, showed the total fall in the 92 miles from the junction of the Sipsey and Mulberry forks to Tuscaloosa to be 163.84 feet. There is 65 feet of fall in the first 25 miles above Tuscaloosa, 107 feet in the first 31 miles, and 129.5 feet to the head of Fork shoals, 48 miles above Tuscaloosa. In the remaining 44 miles the fall is only about 34 feet. The descent is largely concentrated in shoals, where there will be 5 or 10 feet fall within from 1 mile to 2 miles. In the first 2½ miles above Tuscaloosa there is a fall of 24.6 feet. The largest concentration on the river is at Squaw shoals, where there is 41.5 feet of fall in less than 5 miles. Below Tuscaloosa the river leaves the coal-basin, and the slope is much less, there being only 30.1 feet of fall to the mouth, 169 miles below.

The width of the river runs from 400 to 700 feet above Tuscaloosa, and on some of the shoals spreads out to over 1,000 feet. Below Tuscaloosa it gradually diminishes to an average of about 150 feet near the mouth.

The rise from low to high water is very great at places, but shows a large variation, according to the locality. At Tuscaloosa it is 60 feet (63 feet in the spring of 1881); at the foot of Squaw shoals, 20 feet; and at the head of Squaw shoals, 15 feet. At the foot of Fork shoals, just below the mouth of the Little Warrior, the rise is 15 feet, and above the shoals it is 25 feet. At Payne's mill, some distance below the forks, it is 40 feet, and at the junction of the two forks which form the river it is 50 feet. The extreme rise at Tuscaloosa is due to a sudden decrease of the slope and the contraction of the width of the channel from 400 to 300 feet (low water).

The extreme low-water flow at Tuscaloosa has been measured at 455 cubic feet per second, giving a flow of 0.092 cubic foot per second per square mile (indicative of its unsteady character), and 516 theoretical horse-power under a head of 10 feet. The bed of the river is largely sandstone of the coal measures, and there are many sites affording good banks and bed for improvements. The disadvantage to water-power resulting from the extreme rises of the river have been already pointed out, and also the small demand for power. There are two cotton factories at Tuscaloosa, and a spinning-mill proposed, and it is probable that the large power there would be used if it were at all practicable. Above Tuscaloosa there can scarcely be any demand for a large water-power yet.

Utilized power of the Black Warrior basin.—The total power utilized in the Black Warrior basin is 1,161 horse-power, as stated in the census returns, used by fifty-seven flouring-mills, sixteen saw-mills, and four cotton-gins.

In the basin of the Sipsey fork there are eight flouring- and grist-mills, using 81 horse-power; two flouring- and grist-mills, and one saw-mill in the basin of the Mulberry fork, using 72 horse-power; and the basin of the Little Warrior has a total of 506 horse-power, used by twenty-three flouring- and grist-mills, eleven saw-mills, four cotton-gins, and one woolen-mill. The basin of the Black Warrior, exclusive of these, has 512 horse-power in use by twenty-four flouring- and grist-mills, four saw-mills, and one woolen-mill.

The main river is credited with 62 horse-power, used by one saw-mill and three flouring- and grist-mills, in Hale county, below Tuscaloosa. There are two grist-mills on the river above Tuscaloosa, which consist of scarcely more than a pair of burrs with a shed over them.

The Sipsey fork has two flouring- and grist-mills, using 20 and 8 horse-power, under heads of 30 and 7 feet, respectively, and the Mulberry has two, using 15 and 35 horse-power, under heads of 10 and 7 feet, in addition to a saw-mill, using 20 horse-power, under a head of 6 feet.

The Little Warrior river furnishes three flouring- and grist-mills with 24, 18, and 8 horse-power, under heads of 12, 8, and 6 feet, respectively; two saw-mills with 12 and 15 horse-power, under heads of 7 and 10 feet; and one woolen-mill, near the source, with 8 horse-power.

About the most improved of the smaller tributaries of the Black Warrior is Black Water creek, which enters from the north, below the forks. It drains about 290 square miles, and has four flouring- and grist-mills, using a total of 95 horse-power, under 8, 10, and 15 feet head of water.

Mr. Dwight Porter's report treats of the Alabama, Coosa, and other rivers lying east of the Tombigbee.

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